ED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

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COMING SOON

A method for removing carbonates from cyanide plating baths using calcium carbide followed by filtration.

Plating of copper-lead alloys. A report of a study made in an attempt to plate alloys of bearing metal compositions from a single bath.

A practical shop installation for plating tin-zinc alloys from an alkaline bath, including a discussion of the important applications of such alloys.

Several articles on gold plating from the standpoint of high production and uniform color control.

A report of a study made to determine the safe operating conditions for electropolishing baths composed of perchloric-acetic acids.

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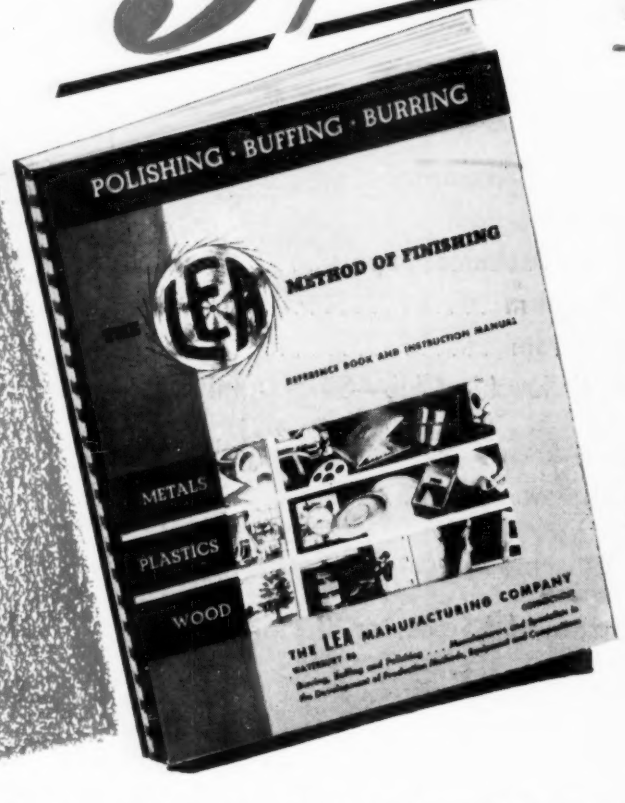

This "textbook" on finishing, based on the accumulated experience of twenty-five years of a constantly broadening service in the technique of finishing, is probably the most comprehensive work on the subject of finishing ever compiled. Comprising 162 well-illustrated and documented pages, it is packed full of useful information and suggestions for improving finishes and reducing finishing costs. It covers the various finishing steps with all commercially used metals, the various plastics and many woods and is divided into three sections (1) Finishing Methods; (2) Actual Case Histories; and (3) Finishing Materials.

Naturally, we hope that those sending for this "textbook" on finishing will call upon the Lea Technical Service for specific recommendations and will utilize Lea Finishing Compounds but no one is obligated to do so and the book loses none of its value. The information contained will be found invaluable regardless of finishing methods or materials used.

When ordering, please use your company's letterhead or order form.

THE LEA MANUFACTURING CO.

16 CHERRY AVENUE WATERBURY 86, CONN.

Burring, Buffing and Polishing... Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions

American Electroplaters Society 36th Annual Convention

Milwaukee, Wisconsin—June 27-30

The 36th Annual Convention of the American Electroplaters Society will be held in Milwaukee, Wisconsin, on June 27th through June 30th. Headquarters for this year's meeting will be the Hotel Schroeder. There will be no exhibits of equipment or materials at this convention, the only displays being those of the various branches on interesting and novel plating jobs. *Mr. William C. Geissman*, of the Milwaukee Branch, is the General Chairman of the Convention.

The technical sessions will feature talks on practical phases of plating and finishing, with several symposiums and a round table discussion taking the spotlight. The convention is expected to draw a large attendance of technical and supervisory executives interested in the newer developments in the field. Plant visitations have been planned to nearby firms so that visitors may observe some of the latest types of equipment and processes in actual operation. Some of the plants to be visited are the Globe-Union Co., Body Division of the Nash-Kelvinator Co., and the X-Ray Division of the General Electric Co.

The symposiums to be held will cover the following subjects:

"The Business of Plating"—This will cover the customers viewpoint of plated items, including statements on the availability of important plating metals and chemicals.

"Copper, Nickel and Chrome Plating"—A general discussion of the most important factors in assuring top-quality performance of these bright finishes.

"Plating and Other Treatments for Light Metals"—Covering the latest developments in the surface decoration of these increasingly important materials.

S. S. Johnston
Supreme President
American Electroplaters Society

The Round Table discussion, which will feature an informal exchange of information between experts and listeners, will cover the subject of *"Acid Dips in Cleaning Cycles."* Reports on the progress of the various Research Projects of the Society will also be made.

Educational sessions will be held on Monday afternoon, Tuesday morning and afternoon, Wednesday morning, and Thursday morning, allowing two open afternoons for the plant visitations and various social functions, in addition to the usual evening entertainment and banquet. A program for the entertainment of ladies attending the convention has also been planned.

EDUCATIONAL PROGRAM

MONDAY, JUNE 27—2 P. M.

Symposium on *"The Business of Plating."*
Chairman—*Walter L. Pinner*, Dir. of Research, Houdaille-Hershey Corp., Detroit.

The Customer Looks at Plated Products—by *Thor H. Westby* and *Robert E. Parkinson*, Merchandise Testing and Development Lab., Sears, Roebuck & Co., Chicago.

Quality Control in Electroplating—by *R. E. Harr*, Western Electric Co., Chicago, Ill.

The Job Plating Business—by *Raymond M. Shock*, Exec. Sec'y., National Ass'n of Metal Finishers, Inc., Detroit.

Availability of Plating Materials—Short presentations of the outlook on availability of "Alkalies, Including Silicates and Phosphates" by *J. J. Duffy, Jr.*, Manager

National Officers of the American Electroplaters Society

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TUESDAY, JUNE 28—9 A. M.

Symposium on "*Copper, Nickel and Chrome Plating.*"

Chairman—*Frank K. Savage*, Star Silver Plating Co., Kalamazoo.

Periodic-Reverse Cyanide Copper Plating—by *George W. Jernstedt*, Mgr. of Electroplating Projects, Westinghouse Electric Co., Pittsburg.

Electrodeposition of Nickel at High Current Densities—by *W. A. Wesley*, Ass't Director and *W. W. Sellers*, Chemist, International Nickel Co., and *E. J. Roehl*, Mgr. of Technical Development, Thomas Steel Co., Warren, Ohio.

Factors Influencing the Operating Characteristics of Chromium Baths—by *J. B Winters* and *R. O. Hull*, R. O. Hull & Co., Cleveland, Ohio.

Scratch Hardness and Abrasion Hardness of Electrodeposited Chromium—by *J. M. Hosdowitch*, Chief Chemist, United Chromium Corp., N. Y.

TUESDAY, JUNE 28—2 P. M.

Round Table discussion on Acid Dips in Cleaning Cycles.

Chairman—*Dr. William Blum*, Ass't Chief, Chemistry Section, National Bureau of Standards, Washington, D. C.

Acid Dips for Ferrous Metals—by *Ivan C. Hepfer*, Pres. Furniture City Plating Co., Grand Rapids, Mich.

Preventing Embrittlement of High Carbon Steel—by *Dr. R. M. Wick*, Bethlehem Steel Co., Bethlehem, Pa.

Acid Dips for Copper and Copper-Base Alloys—by *B. H. McGar*, Ass't Dir. of Research, Chase Brass & Copper Co., Waterbury, Conn.

Acid Dips for Zinc-Base Metals—by *Dwight M. Overcash*, Brown-Lipe-Chapin Div., General Motors Corp., Elyria, O.

WEDNESDAY, JUNE 29—9 A. M.

Symposium on "*Plating and Other Treatments for Light Metals.*"

Chairman—*Mr. K. Gustaf Soderberg*, Editor, *Plating*, Jenkintown, Pa.

Plating on Aluminum—by *Fred Kellet*, Chief Metallography Div., Aluminum Co. of America, New Kensington, Pa.

Cleaning, Acid Treatment and Plating on Aluminum—by *Dr. Walter R. Meyer*, Pres. and Tech. Dir., Enthone, Inc., New Haven, Conn.

Amorphous Phosphate Coatings for Aluminum Alloys—by *F. P. Spruance*, Jr., American Chemical Paint Co., Ambler, Pa.

Plating on Magnesium and its Alloys—by *H. K. deLong*, Lab. Dev. Div., Dow Chemical Co., Midland, Mich.

THURSDAY, JUNE 30—9 A. M.

Reports on the Research Program of The American Electroplaters Society.

Chairman—*Dr. Louis Weisberg*, Consultant, New York, N. Y.

Distribution of Electrodeposited Metal on Some Simply Shaped Cathodes—by *Dr. John Kronsbein*, Prof., and *Lester C. Norton*, Evansville College, Evansville, Ind.

Porous Structure in Electrodeposits—by *Dr. N. Thon*, Princeton Univ., Princeton, N. J.

Plating Room Waste Disposal—by *Dr. Barnett F. Dodge*, Professor, Yale Univ., New Haven, Conn.

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Outing Chairman

Gene Bosl
Exhibits Chairman

Omer Doyle
Plant Visitations

ABSTRACTS OF A.E.S. CONVENTION PAPERS

The Customer Looks at Plated Products

By Thor H. Westby and R. E. Parkinson

A general discussion is offered of characteristics of plated products that the consumer desires, whether or not he has been getting what he wants, and what the plating industry and distributors of products can do to set sensible specifications and to control quality so as to meet these specifications.

Process Control in Electroplating

By R. E. Harr

This paper deals with (1) maintenance of solutions and equipment, including tests and additions to control major solution constituents, spectrographic and other tests for kind and amount of impurities, and rack design and maintenance; (2) inspection, including use of Magne-gage and sectioning to determine deposit thickness, relation of minimum to maximum deposit thickness, establishment of control limits for thickness and use of control charts in maintaining it within such limits, and finish allowances for threaded parts.

The Job Plating Shop Business

By Raymond M. Shock

The role of the job shop in the industry, the present status of activity and profits in the job shop business, outlook for the future, and services rendered by job shop organizations are subjects of this paper.

Availability of Plating Materials

By Eight Speakers.

Background information, present situation, and future prospects will be discussed.

PR Cyanide Copper Plating

By George W. Jernstedt.

Conditions, including time cycles and ratios, solution composition, addition agents, etc., are given for the application of PR to cyanide copper plating. A description of the first inorganic high-speed cyanide solution is given. Examples of the smoothening possible with this process are shown. The method of obtaining various physical properties, especially hardnesses from 100 to 200 Vickers with excellent ductility, is explained. A description of commercial equipment as now available is given, and the operating characteristics of this equipment shown.

Amorphous Phosphate Coating for Protection of Aluminum Alloys and for Paint Adhesion

By Alfred Douty and F. Palin Spruance, Jr.

Details of a new process for treating aluminum alloys and characteristics of the new coatings are given. Data are presented on effects of treatment conditions on coating weight: resistance of painted and unpainted coatings, alone and in contact with dissimilar metal, to outdoor exposure and salt fog test: and adhesion of baked and air-dried paint systems.

Electrodeposition of Nickel at High Current Densities

By W. A. Wesley, W. W. Sellers and E. J. Roehl

The theory of limiting current densities was applied to nickel deposition and led to the conclusion that it is theoretically possible to plate nickel at rates as high as 8500 asf. The practical limit would, therefore, be set not by electrochemical factors but by such engineering requirements as maintenance of an adequate rate of motion of the electrolyte versus the cathode surface, prevention of overheating of contacts, electrolyte and cathode, etc. In a

Chairmen for Milwaukee Convention

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Ladies Chairman

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Walter L. Pinner
Monday Afternoon

Frank K. Savage
Tuesday Morning

Dr. William Blum
Tuesday Afternoon

K. G. Soderberg
Wednesday Morning

Dr. Louis Weisberg
Thursday Morning

controlled-flow apparatus sound nickel deposits were actually made at the rate of 0.001 inch in 16 seconds from the chloride bath, with high anode and cathode efficiencies. Such deposits proved to be less ductile than those made at normal rates but were of good protective value in porosity and atmosphere tests. Electrochemical data are presented which should be useful in designing equipment for high-speed nickel plating and even for increasing ordinary rates by providing uniform motion.

Factors That Influence Operating Characteristics of Chromium Baths

By J. B. Winters and R. O. Hull

The paper deals with the wide variation in results obtained in chromium plating, particularly over nickel. Among the factors that influence the successful application of chromium over nickel are the kind of nickel —gray or bright—addition agents in bright or gray nickel, activation of nickel before chromium plating, passivity of nickel developed after plating either by use of improper transfer cycles or in the chromium bath itself, which is influenced by bath composition (sulfate ratio and strength) and temperature, and time of immersion in the chromium bath before current is applied. Activating dips before chromium are discussed, and mention is made of Hull-Cell control of chromium baths. By appropriate recognition of the factors that enter into chromium plating, consistently good operation can be assured.

Scratch Hardness and Abrasion Hardness of Electrodeposited Chromium

By J. M. Hosdowich

The Scratch hardness of chromium electrodeposited under a wide range of conditions was determined by means of the Bierbaum microcharacter. The abrasion hardness of the electrodeposited chromium was determined by means of an automatic machine in which a grinding wheel was intermittently brought in contact with the test piece. A conclusion of practical value to the chromium plater is that both the scratch hardness and the abrasion hardness of any chromium deposit can be accurately estimated from its appearance—regardless of the temperature and current density under which it was deposited.

Acid Dips in Cleaning Cycles for Ferrous Metals

By Ivan C. Hepfer

Important basic-metal and solution factors, especially those of a controversial nature, are presented.

Prevention of Embrittlement of High-Carbon Steel

By Richard M. Wick

Treatment cycles for minimum embrittlement and for hydrogen removal are discussed.

Acid Dips in Cleaning Cycles for Copper and Copper-Base Alloys

By B. H. McGar

Pickling, stain-removal, and bright-dipping methods are treated.

Acid Dips in Cleaning Cycles for Zinc-Base Alloys

By Dwight M. Overcash

Brief literature survey is made and questionnaire data are given showing present practices in the field.

Plating on Aluminum

By Fred Keller and Walter G. Zelley

The most commonly used process for preparing aluminum for plating, the alkaline zinc immersion process, will be discussed in detail, including effects of surface finishing, structure, and composition of the aluminum alloy. The beneficial effect of chromium over nickel in reducing corrosion of underlying aluminum will be demonstrated.

Cleaning, Acid Treatment and Plating Upon Aluminum

By Walter R. Meyer and Steven H. Brown

Pre-cleaning, alkaline cleaning, etching, chemical polishing and brightening, and electroplating of aluminum will be treated.

Electroplating Magnesium and Its Alloys

By Herbert K. DeLong

This paper furnishes details of cleaning and pickling, final oxide removal and deposition of an adherent zinc film from a pyrophosphate-fluoride zinc dip, copper striking, plating (including barrel plating), as well as stripping methods. Data on outdoor, salt-spray and humidity exposure of silver and copper-nickel-chromium plated panels are also presented.

Distribution of Electrodeposited Metal on Some Simply Shaped Cathodes

By John Kronsbein and Lester C. Morton

Simple, nonmathematical language is used to describe the predictions from theoretical considerations as to how electrodeposited coatings are distributed over cathodes of simple shapes under specified ideal condition, to discuss reasons for predictable and unpredictable deviations of this distribution as encountered under experimental conditions and in the plating shop, and to give some comparisons of theoretical and experimental results.

Outstanding Problems of Porous Structure in Electrodeposits

By N. Thon

The different types of porous structures found in electrodeposits and the factors associated with such structures are discussed. The nature of the metal, thickness of the deposit, conditions of plating, and condition of the surface on which the deposit is formed are considered. Measurements of permeability to air and other gases, permeability to cathodic hydrogen, hydrogen occlusion and adsorption, as well as electron diffraction studies of crystal structure are necessary steps in the attack on this problem.

The Present Status of Plating Room Waste Disposals

By Barnett F. Dodge and C. Fred Gurnham

A number of plants for disposal of all kinds of plating waste will be shown in slides and described.

General Program

SUNDAY, JUNE 26
4:00 P.M.

Registration—Foyer, 4th Floor, Hotel Schroeder. The Registration Fee of $10.00 entitles registrant to a book of tickets which can be used for admission to certain Convention functions and activities as listed in this program.

MONDAY, JUNE 27
8:00 A.M.

Registration—Foyer, 4th Floor, Hotel Schroeder.

9:30 A.M. to 12:00 Noon

Opening Session—Crystal Ball Room, Hotel Schroeder. Invocation by the Reverend *Frank C. Mesle*, Member of the Rochester Branch, A.E.S. President, 1927. Welcome to Delegates, Members and Guests by *William C. Geissman*, General Convention Chairman.

Welcome to Milwaukee by the Mayor.

Greetings from Milwaukee Branch by *T. D. Hartshorn*, Milwaukee Branch President.

First Business Session—*Samuel S. Johnston*, A.E.S. President, presiding.

12:00 Noon

Educational Committee Luncheon—Parlor F, 4th Floor, Hotel Schroeder.

12:15 P.M.

International Fellowship Club's 25th Annual Luncheon (for suppliers and their representatives only)—Empire Room, Hotel Schroeder.

8:30 P.M. to 1:00 A.M.

Open House—Crystal Ball Room, Hotel Schroeder, under the auspices of the International Fellowship Club. Music—dancing—buffet served at 10:00 P.M.

A ticket to this event is included in the pass book furnished to each registrant.

TUESDAY, JUNE 28
7:45 A.M.

Educational Committee Breakfast—Parlor G, 4th Floor, Hotel Schroeder.

8:00 A.M.

Registration—Foyer, 4th Floor, Hotel Schroeder.

9:30 A.M.

National Association of Metal Finishers—Meeting of Board of Directors, Parlor E, 4th Floor, Hotel Schroeder.

12:00 Noon

National Association of Metal Finishers—Board of Directors Luncheon, Club Rooms, 3rd Floor, Hotel Schroeder.

12:00 Noon

Educational Committee Luncheon—Parlor G, 4th Floor, Hotel Schroeder.

6:00 P.M.

National Association of Metal Finishers—Dinner and Business Meeting, Club Rooms, 3rd Floor, Hotel Schroeder.

6:00 P.M. to 11:00 P.M.

Visit to Pabst Brewery—Free Beer—Kalter Aufschnitt—Gemuetlichkeit.

WEDNESDAY, JUNE 29
7:45 A.M.

Branch Secretaries Breakfast—Room to be announced, Hotel Schroeder.

Educational Committee Breakfast—Parlor G, 4th Floor, Hotel Schroeder.

12:00 Noon

International Fellowship Club Golf Tournament—North Shore Country Club. *Joseph J. Duffy, Jr.*, Pennsylvania Salt Mfg. Co., Chairman. Transportation should be arranged through the Golf Committee. Suitable awards will be made. All handicap groups have a chance to win. An informal luncheon will be served at the Club between 12:00 Noon and 1:30 P.M. Tee-off time is between 1:00 P.M. and 2:00 P.M. Bring your clubs and shoes.

12:15 P.M.

Picnic and Outing—Brown Deer Park. Buses leave Hotel Schroeder from 5th Street (East) entrance. Luncheon—Music—Entertainment. A ticket to this event is included in the pass book furnished to each registrant.

2:00 P.M.

Research Committee Meeting—Parlor F, 4th Floor, Hotel Schroeder.

6:30 P.M.

Research Committee Dinner—Parlor G, 4th Floor, Hotel Schroeder.

7:00 P.M. to 11:00 P.M.

Visit to Pabst Brewery—Free Beer—Kalter Aufschnitt—Gemuetlichkeit.

THURSDAY, JUNE 30
7:45 A.M.

A.E.S. Research and Educational Committee Breakfast—Room to be announced, Hotel Schroeder.

2:00 P.M.

Final Business Session—East Room, Hotel Schroeder, President *S. S. Johnston* presiding.

7:00 P.M. to 1:00 A.M.

Annual Banquet—Crystal Ball Room, Hotel Schroeder. Dinner—Awards—Entertainment—Music—Dancing. A ticket to this event is included in the pass book furnished to each registrant.

BRANCH EXHIBITS OF PLATED WARE

East Room, Hotel Schroeder

As the only exhibits at the 36th Annual Convention, the Branch Exhibits of Plated Ware have been given an outstanding display location in one of the attractively appointed banquet rooms of the Convention Headquarters Hotel.

Again, as in the past several years, the Branches are competing for the honor of having a prize-winning exhibit. An impartial committee composed of representatives of five different Branches will have the unenviable task of selecting the three best exhibits.

A visit to the Branch Exhibits of Plated Ware will be well worth the while of everyone in attendance at the Convention and will be a tribute to those Branches cooperating in the Exhibit.

Ladies' Program

SUNDAY, JUNE 26
4:00 P.M.

Registration—Foyer, 4th Floor, Hotel Schroeder. The Registration Fee of $10.00 entitles registrant to a book of tickets which can be used for admission to certain Convention functions and activities as listed in this program. The Ladies Committee will have available for free distribution one theater ticket for each registrant.

MONDAY, JUNE 27
8:00 A.M.

Registration—Foyer, 4th Floor, Hotel Schroeder.

2:30 P.M. to 4:00 P.M.

Tea will be served in the Empire Room of the Hotel Schroeder. This is an excellent opportunity to become acquainted.

8:30 P.M. to 1:00 A.M.

Open House—Crystal Ball Room, Hotel Schroeder, under the auspices of the International Fellowship Club. Music—Dancing—Buffet served at 10:00 P.M. A ticket to this event is included in the pass book furnished to each registrant.

TUESDAY, JUNE 28
8:00 A.M.

Registration—Foyer, 4th Floor, Hotel Schroeder.

1:00 P.M.

Aunt Ella's Society Luncheon Party—Empire Room, Hotel Schroeder, sponsored by *Oakite Products, Inc.*, *D. X. Clarin*, Secretary. You will find the excellent luncheon and entertainment a real treat.

8:00 P.M.

International Fellowship Club's "PLATO" Party—Crystal Ball Room, Hotel Schroeder. Under the direction of *Joan Trumbour Wiarda*. Awards.

WEDNESDAY, JUNE 29
12:15 P.M.

Picnic and Outing—Brown Deer Park. Buses leave Hotel Schroeder from 5th Street (East) entrance. Luncheon—Music—Entertainment. A ticket to this event is included in the pass book furnished to each registrant.

7:00 P.M. to 11:00 P.M.

Visit to Pabst Brewery—Free Beer—Kalter Aufschnitt—Gemuetlichkeit.

THURSDAY, JUNE 30
8:00 A.M.

Registration—Foyer, 4th Floor, Hotel Schroeder.

12:15 P.M.

Luncheon and Style Show—Empire Room, Hotel Schroeder. A ticket to this event is included in the pass book furnished to each registrant.

7:00 P.M. to 1:00 A.M.

Annual Banquet—Crystal Ball Room, Hotel Schroeder. Dinner—Awards—Entertainment—Music—Dancing. A ticket to this event is included in the pass book furnished to each registrant.

SILVER ANNIVERSARY

INTERNATIONAL FELLOWSHIP CLUB

Like many an organization that was to later grow into a place of considerable importance in its field, the *International Fellowship Club* got its start in an inauspicious manner. The occasion was the night before the closing day of the 1924 Convention of the American Electroplaters Society, held in Milwaukee. It is fitting, therefore, that the Silver Anniversary of the Club should also be held in the city of its birth.

The locale for the germ of the idea which developed so successfully was the Coffee Shop (so help me) of the Hotel Pfistor. The time—"after midnight." Those present enjoying a last-minute cup of coffee were *Patrick Bergan*, of Divine Bros., *Frank Clark*, of A. P. Munning Co., *John McCabe*, of Chas. F. L'Hommedieu Co. and *Wilfred S. McKeon*, of Sulphur Products Co.

The discussion of these four revolved around the unsatisfactory status in the Electroplaters Society of the various members connected with the manufacturers and suppliers of electroplating equipment and supplies. These members were not allowed the full status of members, being classified as associate

Louis M. Hague
Chairman, International Fellowship Club

members without the privilege of voting on Society activities or holding office in the Society. In recent years this regulation of the Society has been abolished, but at that time it was strictly adhered to. The supply men had a definite stake in the conventions, and being by their very nature an active and energetic group of individuals, they were not satisfied with their role of by-standers in their chosen field, and many had voiced the desire to form a separate organization of suppliers and manufacturers to take care of the interests of the group and to work with the Society on an equal footing in matters of mutual interest.

This time, when the suggestion to form a separate group was again voiced, the four men decided that now was the time to get started. Those present agreed that Wilfred S. McKeon was the man to see it through. A meeting of all supply men was tentatively set for the following day. The forenoon of the next day after the eventful night meeting in the coffee shop Mr. McKeon met *Mr. Chas. Proctor*, founder of AES. Telling founder Proctor of the previous night's meeting, McKeon stated, "Charley, this organization will stand in neither the light nor the shadow of the AES." That has been literally true ever since. In the last afternoon of the Convention, as booths and exhibits were being dismantled, a "crier" in the form of a bell-boy wandered through the hall announcing the coming meeting, which was held that afternoon. About twenty representatives responded to the call. Mr. Mc-

Present Officers of The Fellowship Club

R. Hazucha
First Vice Chairman

Geo. Nankervis
Second Vice Chairman

A. P. Munning
Third Vice Chairman

T. A. Trumbour
Permanent Secretary

Past Officers of The Fellowship Club

Wilfred McKeon
Chairman 1925-26

George Lawrence
Vice Chairman 1925-26

Ernest Lamoreaux
Chairman 1926-27

George Hogaboom
Chairman 1927-28

Keon acted as chairman of this first meeting, and *Mr. John C. Oberender*, of the Zapon Lacquer Co. was prevailed upon to accept the post of temporary secretary because of his "liking to write letters"—according to Frank Clark.

After an interesting discussion of the purpose of the meeting and the outlining of a plan of action, a committee was chosen to look into the situation further and report at a meeting of this committee to be held at the Hotel Taft, New Haven, Conn., six months later. Members of the committee were *John Oberender*, *George Lawrence*, and *Mr. McKeon*.

This meeting was held, Oberender and McKeon attending, and the concensus of opinion was that there was sufficient interest in such a proposal to warrant recommending the formation of an organization at the next annual convention of the Electroplaters Society, which was to be held in Montreal in 1925.

On the first day of the 1925 Convention, a luncheon meeting was held, all suppliers having been invited to attend. A group of about 16 met, and the club name and officers were decided upon. The club was called the International Fellowship Club in deference to the Canadian hosts, and it was also decided to have a vice-chairman from Canada. The first elected officers of the Club were:

Chairman—*Wilfred S. McKeon*, Sulphur Products Co.

Vice Chairman—*W. W. Wells, Jr.*, of Toronto.

Secretary—*John Oberender*, of the Zapon Lacquer Co.

This first luncheon meeting established a procedure that has been followed every year that a convention has been held, that of having a luncheon meeting on the first day of the Convention. All suppliers are welcome to attend these meetings, the mere payment for one's luncheon constituting the only dues.

The International Fellowship Club meets once a year, on occasions of each Convention of the Electroplaters Society. As explained above, membership is open to all suppliers of equipment or services to the electroplating industry. There are no dues or initiation fees or ceremonies. Meetings are always very informal, a fact which has been responsible for the flexibility and success of the Club.

Beginning with the 1929 meeting at Detroit it was decided to ask suppliers for $5.00 each for the putting on of such entertainment as the committee in charge should specify. This voluntary donation may well be considered as the members "dues." With this money an "open house" was held on the first Monday night of the next convention. A cold buffet supper was prepared and served free to all registrants at about 10 P.M. Refreshments were also furnished to all registrants with compliments of I.F.C. This feature took hold so well that it became an institution, if not a tradition with I.F.C.

At later meetings of the Club it was voted to hold an Open House, sponsored by the Club, on the opening night of each Convention, in order that those attending become better acquainted with each other in a friendly and co-

Frank Clark
Chairman 1928-29

William Schneider
Vice Chairman 1928-29

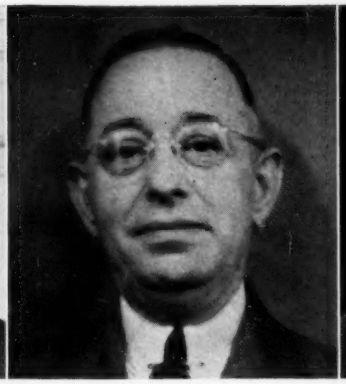
Robert Leather
Chairman 1931-32

Wesley Cassell
Chairman 1932-34

Past Officers of The Fellowship Club

T. B. Haddow
Chairman 1934-35

H. M. Cherry
Chairman 1935-36



John Oberender
Chairman 1936-37

Paul Savage
Chairman 1937-38

operative spirit. These Open House affairs have always proven extremely effective in getting each convention off to a good start. In addition, the Club has for the past ten years arranged a program to entertain the ladies attending the convention, and also sponsors the annual golf tournament which is the high-spot of the year for the industries' par-shooters and hackers alike.

The list of men who have held office in the International Fellowship Club is a veritable "Who's Who" in the industry, all of whom have helped the club succeed in its original aim to promote a clear understanding between suppliers and the plating field as well as between the suppliers themselves.

As an evidence that "nothing succeeds like success," at the 1929 convention held at Detroit it was decided that *Thos. A. Trumbour* was to be made Permanent Secretary.

In Memoriam

The Fellowship Club takes this opportunity to express its deepest gratitude for the friendship and loyalty of the following former officers of the Club who have since passed away:

Mr. W. W. Wells, Jr.
Vice-Chairman 1928-29

Mr. Benjamin Popper
Chairman 1929-30

Mr. G. Cannon
Vice-Chairman 1929-30

Mr. John A. McCabe
Chairman 1930-31

Mr. N. P. Hunter
Vice-Chairman 1931-32

Mr. O. J. Sizelove
Chairman 1938-39

Mr. Jack Geissman
Chairman 1939-40

Mr. A. Fred Norgren
Vice-Chairman 1939-40

Fellowship Club Program

The International Fellowship Club will sponsor the following events during the Convention. All registrants are cordially invited to take part and enjoy the festivities provided through the generous co-operation of suppliers and distributors in the metal finishing industry.

Monday, June 27

12:30 P.M. EMPIRE ROOM-HOTEL SCHROEDER

Annual luncheon **(for suppliers and their representatives only).**

8:30 P.M. CRYSTAL BALLROOM

Annual Open House—Music, Dancing, and Buffet Supper.

Buffet Supper served at 10:30 p.m.

Dancing until 1:00 a.m.

Tuesday, June 28

8:00 P.M. CRYSTAL BALLROOM

Plato party for ladies. Suitable awards will be made.

Chairladies—*Joan Trumbour Wiarda* and *Mrs. R. F. McGuire.*

Wednesday, June 29

12:15 P.M. NORTH SHORE COUNTRY CLUB

Annual Golf Tournament, open to all registrants.

Chairman—*Joseph J. Duffy,* Penn. Salt Mfg. Co. Trophies and awards.

Dave Clarin
Chairman 1940-41

Dick Crane
Chairman 1941-42

Charles Schlott
Chairman 1942-43

Frederick Gumm
Chairman 1944-46

W. D. MacDermid
Chairman 1946-47

Robt. W. Renton
Chairman 1947-48

Joe Duffy
Golf Chairman

Joan Trumbour Wiarda
Plato Party Hostess

TWENTY-FIVE YEARS AGO

Bits of News from Yesteryear

A new method of electroplating rubber on fabrics made possible the manufacture of superior raincoats. The coats were plated after complete fabrication of the cloth garment.

The *Advance Wheel Mfg. Co.* have opened a new office in the General Motors Bldg., Detroit, Mich., under the direction of *Mr. George L. Nankervis.*

The wreck of the airship Shenandoah shocked the whole nation. The dirigible was broken up during a severe storm and fourteen men perished.

LaSalco, Inc., St. Louis, Mo. have purchased the rights, title, and interests of the Bennett-O'Connell Co. and will continue to manufacture the line of generators, lathes and compositions of the latter firm.

When the passage of the Volstead Act outlawed the sour beer widely used in polishing and scratch brushing metals, and near beer proved an unsatisfactory substitute, the industry turned to the use of soap tree bark. Besides proving more effective, this substitution eliminated the occasional disruptions in production caused when a careless supplier inadvertantly included a keg of good beer in with the stale beer shipment.

Royal Plating and Polishing Works have opened a shop at 144 Bleeker St., Newark, N. J. The firm will do job plating of automobile parts and hardware.

The Boston Plating Supply Co. has succeeded the old Boston Platers Supply Co. and will continue the business at 202 Friend St., Boston. *Mr. M. E. Baker* will head the new firm, aided by *Mr. B. F. Lee.*

Officials of the Bulgarian National Bank were alarmed over the possibility of losing the entire issue of their new coins, about 100,000,000 leva. The coins were made of an aluminum-zinc alloy, and were crumbling into dust, due to faulty composition of the alloy.

The largest rectangular wooden pickling tank made up to this time was recently shipped by the *Kalamazoo Tank and Silo Co.* to the Champion Spark Plug Co. An entire flat car was necesary to transport the tank, which measured 43 ft. long by 7½ ft. wide.

The round-trip railroad fare to the Montreal Convention of the AES was $22.42, lower berths $7.50 extra. A special car carried members from the New York area attending the Milwaukee convention.

The *J. B. Ford Co.* will exhibit its line of Wyandotte metal cleaners at the coming Steel Treaters Convention in Cleveland. Chief Little Bear, a genuine Indian, will head the Wyandotte delegation.

Hollowed out shoe trees, into which ice could be placed, were the subject of a recent patent in England. The idea behind it all was that iced shoes would permit all night dancing in hot weather!

The Chas. F. L'Hommedieu & Sons Co. have just placed a contract for the construction of a warehouse on their property adjoining the C.B.&Q. R.R. at an estimated cost of about $10,000.

J. Holland and Sons have now entered into the buying and selling of second hand and new polishing and plating equipment, at their 489 Broadway, Brooklyn plant.

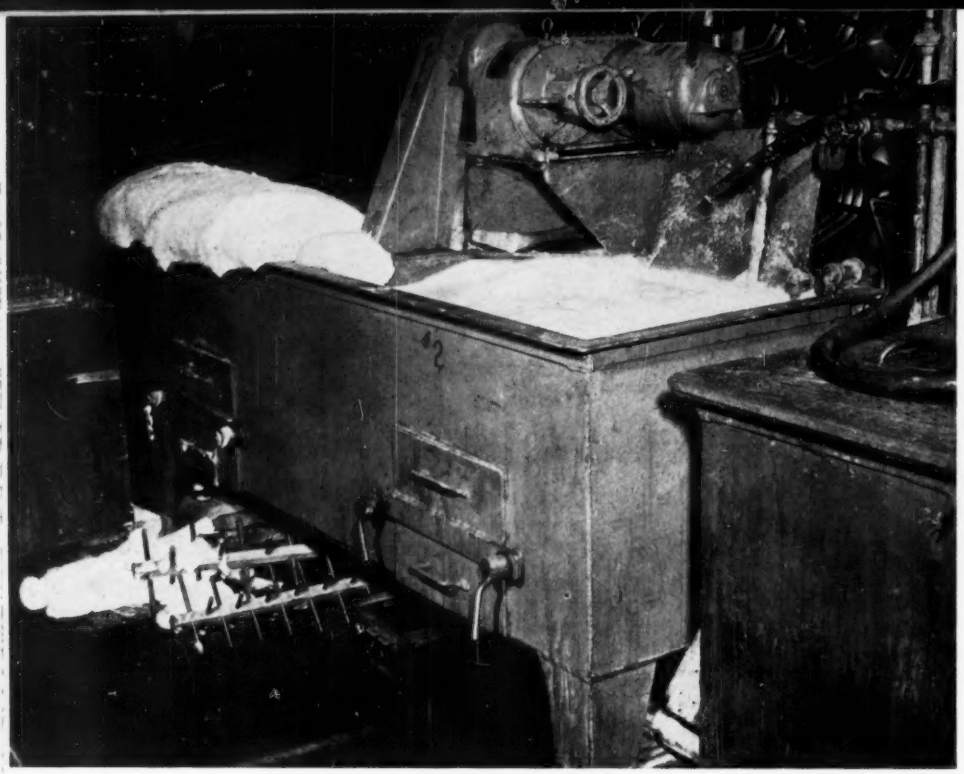
Crown Rheostat & Supply Co. has moved to its new building at 1910 Park Ave., Chicago. The building is brick, and consists of two stories and a basement.

The first edition of "Principles of Electroplating and Electroforming," by *Blum and Hogaboom*, was published. (A revision of this long-lived text is due to be published this Fall.) (1949 that is!)

Charter Members of the International Fellowship Club

The following members of the International Fellowship Club were present at the first organizational meeting of the club held in Montreal in 1925.

Mr. Chas. H. Proctor (Deceased)
Mr. Frank B. Clark
Mr. R. H. Sliter "
Mr. N. P. Hunter "
Mr. Thos. B. Haddow
Mr. Harry C. Flanigan "
Mr. R. J. Hazucha
Mr. S. L. Cole "
Mr. Frank Terrio
Mr. T. A. Trumbour
Mr. G. A. Tanner "
Mr. W. G. Stoddard
Mr. B. Popper "
Mr. Wm. M. Schneider
Mr. Van Winkle Todd
Mr. J. C. Oberender
Mr. G. J. Lawrence
Mr. Wilfred S. McKeon



(All photos courtesy of Bendix Aviation Corp.)

Submerged Abrasive Burnishing—Part II

By Joseph E. Wingate, *Barrel Methods Engineer, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.*

Preparation for Submerged Barrel Burnishing

A CASUAL glance at a group of different parts may indicate that a limited number of this group may be safely and economically abrasive burnished, but often the entire group may be processed in barrels, providing minor steps are taken to assist the process.

Operations to assist burnishing, such as the removal of heavy burrs caused by cutting tool runout, or partial removal of excessive drilling burrs, are classified as pre-breaking. The over-looking of this pre-breaking operation is responsible for limiting the great savings now being affected in many manufacturing establishments.

A comprehensive knowledge of when and how parts may be partially hand burred, prior to barreling, is a requisite if full advantage is to be extracted from the burnishing equipment. Knowledge of this nature is only gained from experience and the exercising of common sense. One case will be cited to impress barrel users with the importance of thinking along these lines (see Figure 10).

A small aluminum key requires radii of 1/32" on four corners. Machined surfaces must be free of burrs and maximum allowable break on remaining edges is .005" to .010".

To process this piece using conventional hand methods, one minute and forty-five seconds would be consumed. By applying a pre-breaking procedure, we arrive at this result: Hit the four corners requiring the 1/32" radius on an emery disc. This requires 10 seconds. Remaining requirements are of such a nature that submerged burnishing will accomplish them. As 10,000 pieces of this size could be accommodated in a single drum, the savings are obvious.

When parts contain small blind holes or slots, risks of these openings becoming clogged with broken or depreciated media often discouraged barreling. To remedy this condition, these steps may be taken: If openings are large enough, small corks or rubber plugs can be inserted prior to barreling. These can be used many times, and the cost is low. When slots or holes prohibit the use of plugs or corks, a simple expedient is to push a small ball of parafin into the opening. After tumbling, this material can be removed in mass quantities simply by using a vapor degreaser.

An instance where special steps were necessary to permit barrel treatment is illustrated in Figure 11. To prevent damaging the threads on these long shafts, they were mated together and barrelled in lengths of 4 parts.

Often, parts are of such physical size and weight that metal-to-metal contact will destroy surface finish as rapidly as it is created in the drums. Where superfinishing is required on parts of this nature, racks or fixtures can be constructed to properly protect the parts during processing. One of the simplest and most efficient types of rack is the multiple cross rack. Precision gears, housings and shell castings can be readily barreled on such a device. Final design will be, of course, dictated by size, shape and weight of part. See Figure 12.

Manufacturing practices in a great many instances involve oils, greases and many type soils that require removal before burnishing operations can be used.

Visual inspection will determine whether or not an operation to clean or remove greases or foreign matters is necessary. If parts are clean to the touch, they are sufficiently clean for barreling, but few parts in process fall into this category. Definite procedures should be established to prevent parts being sent to the barrel in a soiled condition.

There are two methods of accomplishing this. One of the most practical and versatile is vapor degreasing. This method is capable of freeing parts of the most viscous types of oils and greases without affecting the parts. Certain occasions require the use of earths, leads, or caky compounds. The simple procedure of slushing parts in this condition for a few seconds in very light petroleum oil will saturate the part to the extent that the degreaser will readily remove the combined matters.

Today most vendors of soaps and detergents are also able to supply compounds capable of emulsifying and dispersing foreign matter on parts. Caution should be used to avoid the use of excessively strong or over-heated washes. Etching, warping, or distortion may result.

Handling of Parts

Prior to and after barreling, all parts receive a certain amount of handling. The manner in which these parts are transported to and from the barrels will be largely responsible for praise or criticism of the barreling process. It is ridiculous to assume that, because a part is going to be submerged burnished, indiscriminate dumping, piling up or dropping can creep in as general practice. It must be borne in mind that even if fragile parts can be successfully barreled, heavy digs or nicks cannot be removed without possible overloading of the smaller parts. In most instances, the raised or protruding edges of nicks can be honed down, but the subsurface area will not be improved. Where surface erosion of up to .001" to .003" is permissible, the entire nick in many cases can be removed, providing, of course, the greatest depth of the mark does not exceed this measurement. Therefore, it should be remembered that in order to prevent damaging of parts, every lot of work should be handled carefully. Where practical, precautions should be taken to prevent dumping or dropping into containers without proper cushioning, or from heights that would subject the parts to metal-to-metal impact. More jobs have been condemned to the scrap pile or required additional rework operations through thoughtless handling than has ever been caused through the action of the barrel itself.

Too much caution cannot be exerted in the loading of parts into the barrel. Many cases are on record where parts had been mangled and distorted before the barrel had ever been turned on.

Handling & Storage of Stone

An important phase of abrasive burnishing is the grading or sizing of the media. If good results are to be expected, sizing of the stone must be done regularly and care taken to assure proper separation and storage.

For grading, any reliable multi-decked mechanical screen can be used to advantage. Some rotary-type screens are also capable of doing this job, but as a rule this machine is not sturdy enough to use for the finer screenings required. A good suggestion to follow in establishing a group of useful sizes is to start with a ½" stone and grade in decreasing increments of ⅛", making the largest size ½" and the smallest size ⅛". This segregation creates five useful sizes, the fifth size being that stone that falls through the ⅛" mesh. This fine stone is decidedly useful for the deburring of small gears and slots, and may be used until entirely depreciated for such purposes.

Many will ask why ⅛" stones are considered to be the smallest useful size, whereas steel balls as small as 1/16" are sometimes used for burnishing. As previously stated, all abrasive stones acquire a slightly irregular shape. The tiny bumps or imperfections offer considerably smaller radii or contact points to the work than is offered by a 1/16" ball. See Figure 13. As this ⅛" stone is decidedly easier to work with and handle, there is really no need for sizes smaller than this.

The physical handling and storage of the abrasive medium requires only average common sense. As only excessive carelessness can affect this stone, it may be dumped, poured or swept around the floor with almost reckless abandon. The only necessary precaution to take is that of protecting the stone from grease and oils. When the stone becomes contaminated with oils, it will be found necessary to wash them by tumbling for ½ hour in a mild soap solution and thoroughly rinsing.

As for storage, daily or long term, any kind of a container will suffice, the most practical for daily use being the sheet metal bin.

Curing of Stone

It is easy to understand that in any stone crushing process a certain amount of foreign and deleterious matter will creep into the material being worked. In spite of rigid precautions, this undesirable matter includes small splinters, pieces of earth, oils and greases that might drain from the machinery being used, and most important, a great amount of abrasive dust. Many barrel processors have neglected to consider this angle, and the results of their efforts to obtain a high burnish have been disappointing.

In order to get optimum results from a submerged burnishing barrel, steps to assure clean, smooth media must be considered. A satisfactory process for producing good clean media is:

1. Wash new stone in clean water in any convenient container, with agitation. This will float away pieces of wood and a certain amount of oil.
2. Place media in any usable tumbling barrel and barely cover with water. Add 1 oz. per gallon of soda ash, close the barrel, and revolve one hour. This will remove other tenacious oils and greases, and soften earth deposits clinging to stones.
3. Replace old solution in the barrel with a new solution consisting of enough soap compound and water to produce a heavy lather. Close barrel and

revolve for one hour. This heavy lather will float away much of the dust and grit that was embedded in the pores of the material.

4. Dump this soapy solution, replace with clean water, and revolve barrel for forty (40) hours. Inspect the stone mass periodically and change the water as required to avoid a milky condition.

At the completion of this process, the media will be smooth and free of any matters harmful to the process, and may be placed in use or stored for future use. See Figure 14.

Where organizations fabricate parts that require deburring as well as burnishing, this complete pretreatment of stones can be accomplished automatically by using the stone directly from the manufacturer for deburring purposes. After being used for at least forty (40) hours, the media may be used for burnishing. It is our policy at Eclipse-Pioneer Division to use the latter process.

Barrel Cleanliness

Any piece of equipment used in a process involving the use of soaps or chemical cleaners will ultimately acquire a film of alkaline smut. Despite constant cleaning and rinsing, a certain amount of this contaminant will adhere to the sides of the tank and the outsides of the drum or any part of the mechanism where abrasion or burnishing action does not retard its growth.

Controlling this smut is important. Accumulations of this matter pollute the burnishing solutions to the extent that suds and lather form in a heavy blanket atop the drums, leaving the media and parts in the drum in such a manner that improvement of polish is impossible.

In order to avoid poor results, a definite schedule and routine should be established for keeping the equipment free of matter harmful to the process, as follows:

1. Use hose and clear water and rinse out the drum. Wash off the stone and sides of the equipment at the conclusion of each cycle.

2. Mix an acid solution consisting of hydrochloric acid (25%), nitric acid (30%), and clear water (45%). This mixture should be slushed on all internal parts of the equipment, and let stand for approximately 3 minutes. Flood with clear, fresh water. This should be done at least once every 6 months. If required more often, the user can rest assured that he is using the wrong kind of soap.

Where long weekends and holidays necessitate shutting down equipment for several days, a concentration of ½ oz. soda ash to a gallon of water left in the tanks will prevent rust and oxidation. To prevent souring and bacterial growth, a disinfectant should be added. Any standard reliable phenol-base product will suffice.

Selection of Proper Size Media

When selecting a particular size media for a part that is adaptable to abrasive burnishing, certain principles must be remembered. There is a definite range of useable sizes of stone. The largest useable size capable of imparting a high lustre to a part is ½" diameter. The smallest practical size is 1/16". Stones larger than ½" are seldom used to super-finish, as the action is too harsh.

For submerged deburring, prior to burnishing, the larger sizes are selected when practical. Exhaustive tests indicate that large stones grind more rapidly and have less polishing action than small stones. Media ¼" and under grind slower, but impart smoother and more lustrous surfaces.

Proper selection of stone size usually involves more than meets the eye.

Where possible, select a stone capable of finishing parts to desired limits with a weight as near possible as that of the parts to be processed. A good example of this case would be finishing a .006" thick brass shim. Although a stone ⅜" in diameter would deburr and impart the desired finish, the danger of bending the piece, due to the weight of the stone being so much greater than that of the part, would arise. For a part of this nature, media ⅛" in diameter would require a longer cycle, but would do a superior job without danger of distorting the parts. Figure 15 illustrates this condition.

Light aluminum parts treated in ½" stone would have a tendency to group together in the mass, or partially ride atop the media, rather than disperse themselves evenly throughout the mass. On the other hand, compact steel parts would act similarly in 1/16" stone. Nicks and digs would then be created in the parts due to part-to-part contact.

Selecting a media capable of creating proper stone-to-part contact is also of great importance, as it is necessary to use a stone capable of making contact with all surfaces of the parts. On small symmetrical parts containing no slots, holes or intricate configurations, a single size stone is preferable. This eliminates excessive handling when separating media and parts at the conclusion of the burnishing operation. Where parts contain slots, holes and irregular surfaces, a mixture of two sizes may be required. When this procedure is in order, the mass should be composed of about 25% large and 75% small stone. Some question may arise as to why this particular mix is prescribed. As previously stated, large stone cuts faster than smaller stone. Therefore, shielded surfaces reached only by the smaller stones would receive improvement more slowly; therefore a larger amount of the small stone is required to prevent the free or unprotected surfaces from being over processed during the time required to bring the holes, slots and sheltered areas to requirements.

Media selected to process slots and openings must be capable of passing freely through these parts. Borderline sizes should not be considered. If the mass of stone used contains slightly elongated pieces, their shortest dimension should be at least .020" smaller than the slots to be processed. Otherwise, stone removal from slots and holes will prove annoying and expensive.

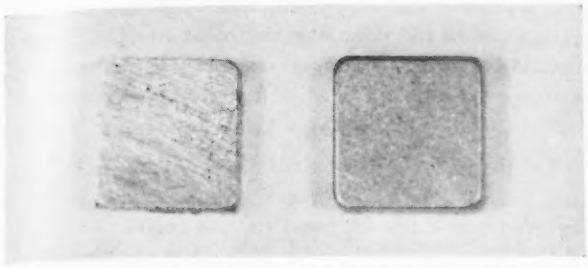


Figure 10. **Pre-breaking the burr on this small aluminum part permits subsequent barrel finishing at a considerable saving in costs.**

Parts having internal diameters of 1/16″ or less should be hand processed. Media small enough to freely pass through the opening does not offer sufficient abrasive action or weigh enough to produce much effect, unless very long time cycles are used (10 hrs. or more). Lengthy cycles of this nature are foreign to the usual two to four hour run usually found sufficient for other surfaces of the parts.

The remaining, but by no means insignificant factor left to consider when selecting media is that of media and part separation. When mixed stone sizes are used, part size and media size should in all cases differ sufficiently so that two screens placed one above the other would clearly separate the mass into its three original components. Screen No. 1 should trap the parts, Screen No. 2 should trap the larger sizes of the media, and the smallest size should free itself of all holes and slots and fall through the second screen to a proper receiver.

Proper size media should not be too difficult to select due to the limited range of useable sizes. The following table lists a versatile range of sizes along with recommendations for various metals, assuming of course the parts are reasonably similar physically:

Size	Use For
½″-7/16″	Steel R/C 30 & up.
⅜″-5/16″	Steel R/C 30 & under-Stainless steels.
¼″-3/16″	Brass, Bronze, Zinc, Silver.
⅛″-1/16″	Magnesium, Gold, Aluminum, Platinum.

Sizes under 1/16″ make excellent media for deburring gears and very tiny parts processed in sub barrels. This size media will require water ports having smaller holes than the previously mentioned ⅛″ holes. In the standard drums this 1/16″ media passes out of the drums through the water ports and may be gathered from the bottom of the tank. Thus the drum itself acts as a size classifier.

When processing precious metals, steps must be taken to salvage the material eroded. Residue in the bottom of the tank may be collected and processed to recover these metals.

Barrel Speed

Barrel speed can make or break a submerged burnishing program. Therefore, it is prudent to give full consideration to this phase of the subject.

Questions as to what is the proper speed for the barrel have absolutely no meaning unless barrel size, type of part, and finish requirements are given. It should be pointed out that R.P.M. should be associated with burnishing only as a medium for measuring the *surface feet per minute* of the barrel.

All barrels, regardless of diameter and length, have a fixed speed in feet per minute at which they can safely and efficiently burnish. Experience has indicated that the surface speed of the periphery of the barrel is the only true indicator of the action taking place in a barrel. To bear out this statement, let us cite an actual example where a 30″ diameter barrel was compared with a 15″ diameter barrel. Our problem was to deburr and burnish to three micro-inches a clutch disc 3⅜″ diameter and .027″ thick. This disc is made of soft bronze. By running each barrel at 45 R.P.M. for 2 hours the 15″ barrel produced a lustrous, smooth part measuring 2.9 micro-inches average. The part taken from the 30″ barrel measured 18 micro-inches, and was battered beyond use! The actual peripheral speed of the 30″ barrel was 354 feet per minute, while the speed of the 15″ barrel was 177 feet per minute.

Even after exceeding the 177 feet per minute by 25%, the results were the same; the slower burnished parts were excellent, the faster processed parts dished, the edges rolled over, and the micro-inch finish measured 10.

Several worthwhile rules to remember regarding barrel speed are:

1. A peripheral speed of over 225 feet per minute will not do a superior super-finishing job.
2. Rigid parts may be processed at a higher speed and with larger stones than fragile parts.
3. The reduction in speed required when barreling fragile parts lengthens the time cycle.
4. The relationship of smallness and fragility is consistent throughout barrel practice. The more fragile the part, the smaller the stone and the slower the speed required to attain the desired result.

Overloading

Burnishing barrels may be overloaded in several ways:

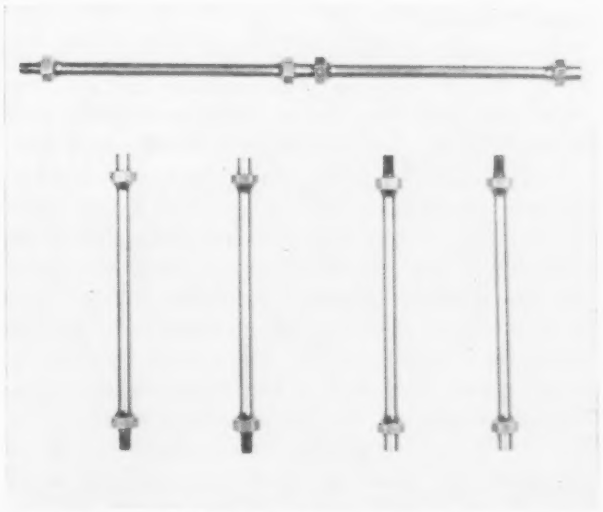


Figure 11. **Six inch long studs, when mated as shown in groups of four pieces, are readily barreled to burr the hex flats and improve overall surface finish.**

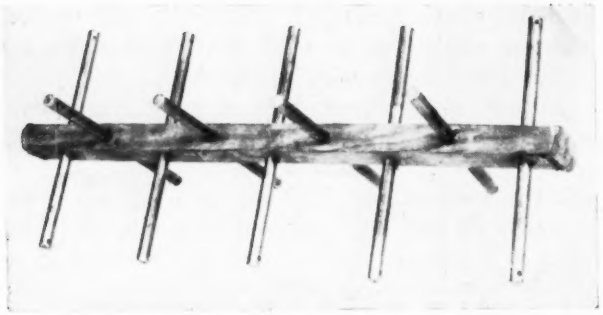


Figure 12. Multiple cross rack; parts are wired to the pins to prevent damage during the barreling operations.

1. Ratio of parts-to-stone too great.
2. A combination of stone and parts being too great in proportion to the size of the drum.

All instances of this nature result in failure to attain maximum results. Too great a ratio of parts-to-stone causes nicking and digging of edges and surfaces. A combination of too many parts and too many stones per drum offers the most interesting case. The following test run illustrates the results of such a combination.

Drum size	Hexagonal 17½″ long, 15″ dia.
Stone load	400 lbs., No. 4 stone (¼″)
Work load	18 lbs.
Cycle	2½ hours
Barrel R.P.M.	24
Specimen	Aluminum 1/32″ thick

Prior to barreling, all surfaces and corners showed normal drawing and shearing burrs. Upon examining the specimens at the conclusion of the 150 minute run, the parts showed a dull burnish over the entire outside surface. The inside surface had been washed clean but no apparent surface improvement was visible. All corners and edges retained a small burr and small holes on the flange surface showed no change.

The lack of lustre and failure to deburr or improve edges comes from the parts and stones being so compacted in the drum that position change or creation of a rolling action of the mass was prevented. No amount of burnishing under these conditions would improve this part.

A second run, using identical conditions to the above, but reducing the stone load to 200 lbs., produced parts that were lustrous, properly rounded on all important edges, and had a finish of 6 micro-inches.

A bystander in the near vicinity of a correctly operated barrel in process would hear a gentle, rhythmic clicking sound. This sound is attributable to the outer fringe of media being roll-heaved gently against the opposite side of the drum. This clicking cycle is proportional to the speed of the barrel, and the sound level is governed by the size and amount of media used. This clicking sound can be used as an excellent telltale of the internal action of the drum. Where a barrel is properly loaded, this sound is not objectionable. When underloaded or operated at too high a speed, the drums immediately acquire a clatter or thudding sound. This is the result of too much mass being thrown against the far side of the drum. The sound given off by the tumbling mass is a true indication of the action taking place in the drum and should be used as an audial check of the process.

Stone Load

In attempting to master submerged abrasive burnishing techniques, considerable thought must be given to the stone load. A good rule to follow is to never let the stone load fall under 55% of the volume of the drum, regardless of the size of the drum or stone, while the maximum stone load must not exceed 80% of the drum volume. The smaller load is preferable for burnishing small, solid parts such as rollers, pins, shafts, plates or washers over .030″ thick. The largest load is desirable when processing shells and fragile work down to .002″ thick. One of the interesting exceptions to this rule is the case of polishing heavy compact pieces that are symmetrical. This exception is due to a greater amount of action being created by the weight of the part causing it to roll through the mass of smaller stone more freely, and a greater amount of stone is therefore required to prevent metal-to-metal contact. Experience shows that a smaller load functions more efficiently when composed of the larger stones from ⅜″ to ½″ diameter. The larger load functions with superior results when composed of ¼″ diameter stone and under. Loads falling in between these two may be slightly mixed in size if the areas being processed permit or require mixtures, always remembering that the larger size stones deburr and polish faster, and the smaller size stones impart a higher lustre but require a longer cycle.

For processing very large or bulky parts, the ratio of stone volume to barrel volume must also increase if nicking or impinging is to be avoided.

The following table is of value in maintaining stone-to-barrel ratios:

TABLE II

Stone Size	Percentage of Total Volume
½″	55%
⅜″	60 to 65%
¼″	70%
⅛″	80%

The last ⅛″ stone ratio is for precision burnishing such as creating a micro-inch reading of 2 R.M.S. and breaking corners to .0008″, removing only an infinitesimal amount of stock from surfaces.

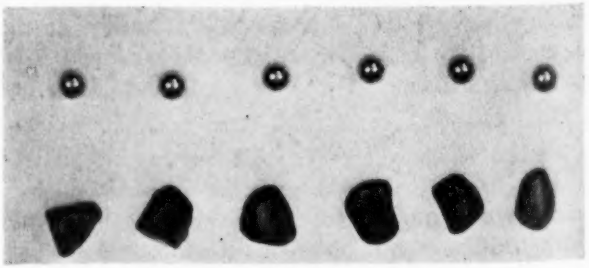


Figure 13. Comparison of working radii of small steel balls and much larger abrasive stones illustrates why stones can reach into recesses in spite of their larger size.

Some occasions will arise when parts are so fragile that ¼" stones would create sufficient stone surface for the part to bend around, or several ¼" stones would trap the part in such a position as to distort it. Figure 16 shows an example of such a case. Parts of this nature can be satisfactorily burnished and deburred by loading the drum to 90% (stones plus work) capacity, although the burnishing action is greatly retarded by this amount of parts and stone. In this case, the lack of action may cause the cycle to run as long as ten (10) hours, but as the submerged burnishing process is the only practical and economical method of handling work of this nature, a concession may have to be granted in such cases.

Stone-to-Part Ratio

Correct stone-to-part ratio is of utmost importance if satisfactory results are to be expected from the submerged process. First an effort should be made to understand how this ratio affects the results.

As is true in any kind of abrasive barrel work, the parts being processed should be exposed in such a manner as to provide abrasive-to-part contact over all surfaces, without the danger of part-to-part contact creating nicks and pits.

In order to illustrate one of the cardinal principles of all tumbling operations, use will be made of the term "box volume" of a part. This "box volume" or more simply "box" is the theoretical cube formed by multiplying the three longest dimensions of any part. For example, an "L" shaped part of sheet metal 4" wide and having legs of 5" and 2" would have a corresponding "box" of 40 cubic inches.

Now, common sense will show that in order to avoid the mentioning nicking by part-to-part contact, a non-symmetrical part with a given "box" volume will require a greater amount of stone in which to roll without hitting the other parts than would be required by the same "box" of a symmetrical part, as more of the "box" of an unsymmetrical part is composed of the stone. Individual judgment must be exercised here as in any other skilled operation, and the following may be helpful in classifying parts.

A part may be classified as symmetrical for burnishing when the product of the two larger dimensions is not more than double the third dimension. Example: A 1" cube is classified as symmetrical because the product of the two greater dimensions 1" x 1" does not exceed the remaining dimension (which is 1") by

Figure 14. Left—standard No. 6 media as obtained from vendor. Center—after 40 hours' use. Right—after 200 hours' use; all sharp edges have rounded off, giving a material suitable for fine burnishing.

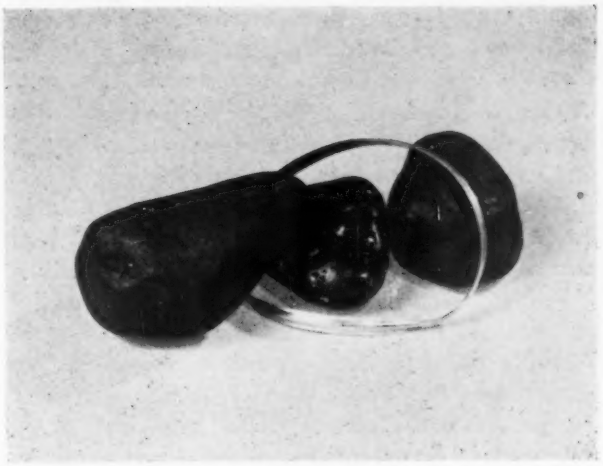


Figure 15. Use of media which is too large for the parts, causing bending and distortion. Note that very little support is available for the parts over most of its area.

over 100%. Two 1" cubes placed end to end still fall into this symmetrical group. By placing three 1" cubes end to end we create an unsymmetrical condition, however, as the product of the two greater dimensions 3" x 1" = 3" is more than double 1".

The three factors which must be considered in arriving at a satisfactory stone-to-work ratio are:

1. Shape of parts.
2. Weight of parts.
3. Materials from which parts are made.

The shape of the pieces may be classified into two groups—symmetrical and unsymmetrical. The weight should be divided into groups of 1, 2, 4, 8, and 16 ounces. Parts over 16 ounces in weight usually require individual handling, such as on racks or fixtures. The materials are divided into two broad groups, ferrous and non-ferrous.

The following table (arrived at through actual production tests) will illustrate the proper ratio for 2 ounce parts:

TABLE III

Type of Part	Parts Stone	Parts Work
Ferrous symmetrical	12	1
Ferrous unsymmetrical	22	1
Non-ferrous symmetrical	19	1
Non-ferrous unsymmetrical	26	1

As the weight per piece increases, without excessive change in the physical size of the piece, this ratio of media-to-work must also increase in order to compensate for the greater part-to-part pressure created. Increasing the media ratio in this case surrounds the part with a greater amount of stone which will serve as a shield to prevent nicking and damaging edges which might otherwise be caused by part-to-part contact.

Water Level

Varying the standard water levels produces many interesting results. As complete coverage of the effects of varying the water level for the four stone sizes

would require excessive elaboration, only one comparison will be given, that of the ⅛" stone size and the "overloading of the tank with water."

The finest surface polish, the smoothest surface finish, such as is required to create a super-finish of 2 micro-inches and break corners to a maximum of .0008" on a precision piston or valve can be obtained by the use of the ⅛" stone and a water level 2" under the mass. The following procedure could be used. Properly load media, stones, and parts to drum. When it comes to the water adding stage, add sufficient water to bring the level 1" above the mass. Close barrel and start burnishing. Only a gentle smoothing-out or fine polish occurs. After burnishing in this manner for 2 hours, stop barrel and reduce water level to 2" under the mass. Continue cycle. The reduction in water level will speed up the burnishing effect on the surface and also break the corners at a faster rate.

After 1 hour, measurement will show a surface of 2 micro-inches and a broken corner of .0006" to .0008", which is the desired condition.

A brief summary of the effect of high water levels will enable the operator to match or control within reasonable limits the superficial appearance or color of steels varying in hardness. To bring about varying degrees of lustre where desired, all metals can be toned or dulled to a desirable finish, without affecting the measured surface finish, simply by adding additional water and burnishing for 30 minutes longer than required in the original cycle. As a super-finish by measurement and a matte or satin finish by optical inspection is often desired to eliminate contrast of mating or adjacent parts, the burnished part having the higher lustre of the two can be matched to the finish of the non-burnished part, or to any degree of color desired simply by raising this water level. Figure 17 shows the practices followed in the Bendix plant.

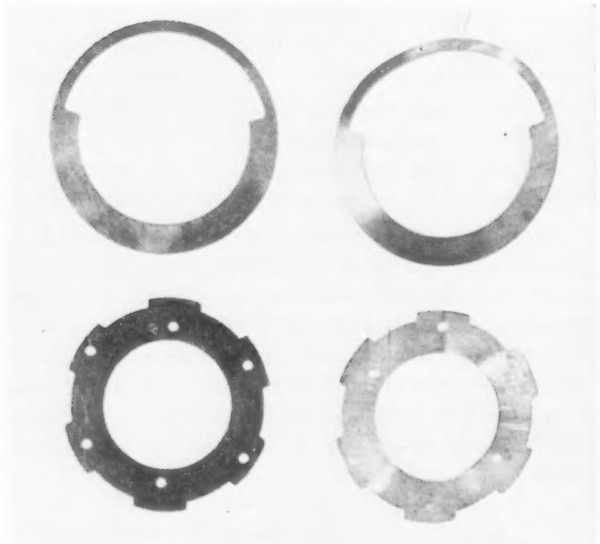


Figure 16. Bent and distorted parts on the right indicate improper work load. Decreasing the proportion of parts to media will overcome this fault.

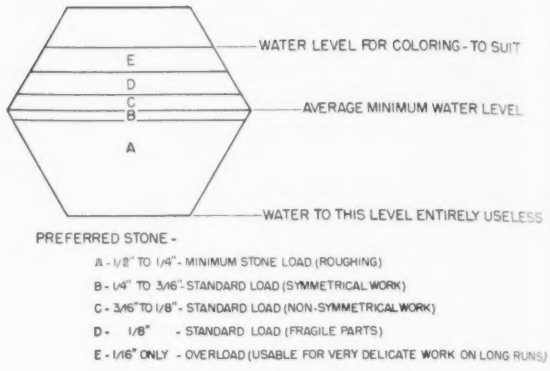


Figure 17. Chart of water levels and stone sizes to produce various results.

Drying and Oiling

Consideration must be given to the after-burnish treatment of all parts. Where ferrous and non-ferrous parts are burnished for micro-inch reduction and deburring only, a rinsing in clear water and a thorough slushing in water-displacing and protective oil is required. In this case the lustre of the part will be dulled by the oil, but removal of the oil will return the visual appearance again. The purpose of the rinsing is to remove any suds or soap film carried over from the barrel process. The purpose of the oil is to protect the parts from rust and tarnish. Several excellent water-dispelling and protective oils are now available for this after-treatment. Parts may be dipped while wet and left in the protective oil for 20 seconds, removed, drained, and stored or shipped to later operations.

Parts that are burnished primarily for lustre can be successfully dried and the polish preserved by the use of infra-red lamps or sawdust drums.

The speed of the sawdust drum should be sufficient to merely tumble the sawdust mass so as to expose different areas of sawdust to the part. For a 30" barrel the maximum speed should be 8-10 R.P.M. The barrel can be constructed of either sheet metal or wood. Excellent types of drying barrels are available with a steam jacket for drying the sawdust. Care should be taken to avoid the use of contaminated or damp sawdust as this will mar the lustre of the part.

When a group of very fragile parts, such as shells or shims, are to be sawdust dried, the addition of about 30% of hard maple blocks (½") will tend to keep the parts from being nicked.

Summary

It is hoped that the foregoing discussion on the submerged barrel burnishing process will arouse the interest that its value and versatility warrant. In the author's plant it has become a most important production process, handling jobs that were not previously thought suitable for barreling, and doing other jobs where fine surfaces are required in an economical and efficient manner.

Refinishing Hollow Ware

By Joseph Haas, *Metal Finishing Consultant.*

HOLLOW WARE for refinishing usually comes from private homes, restaurants, or hotels. Such articles generally consist of trays of various types, coffee and tea sets, bowls, vegetable dishes, candlesticks, and many miscellaneous novelty items.

The main body of any particular hollow ware article may, in the order of quality, consist of sterling silver, nickel-silver, copper, brass, Britannia Metal, and pewter. Of recent years considerable aluminum hollow ware has also been made.

Articles of hollow ware, except Britannia, pewter and aluminum are ornamented with soldered attachments of varied designs, giving them a style or pattern. The ornamentations or mountings on sterling hollow ware are stampings of sterling, or castings of silver. For nickel-silver hollow ware, any mounts are generally of nickel-silver or copper. For copper and brass hollow ware, the mounts may be copper or lead, depending upon the quality of the particular piece of hollow ware.

This article deals primarily with plated hollow ware. Repair of sterling, pewter, and aluminum will be obvious from operations described here for plated hollow ware.

Plated hollow ware (base metal nickel-silver, copper, or brass with various types of mounts listed above) may be silver plated or chromium plated. Brittania metal may be silver plated, or left in its natural color. In its natural color, it is often sold erroneously as pewter. Therefore, an explanation of what constitutes Britannia Metal is in order. The base of Britannia Metal is 90% tin, with varying amounts of antimony and with or without copper, the copper not to exceed 3%. Consequently Britannia Metal may be considered principally tin, hardened with antimony. However, alloys containing even lead, with copper, and antimony, so long as the tin content is 90%, are still classified as Britannia Metal.

Pewter is always left in its natural color, as originally placed on the market, although the job shop may be requested to silver plate it. Pewter is properly an alloy of tin and lead only, tin 85%, lead 15%, although as stated under Britannia Metal, an alloy of tin, antimony and lead is sometimes sold as pewter. Commercially we also find that bowls, plates, tea pots, sugars and creamers sold as pewter will have the following composition:

Tin	79%
Antimony	7%
Bismuth	2%
Copper	2%
Lead	10%

The Author

Mr. Haas is one of the early pioneers in the plating industry, and has made many important contributions to its growth and development. A licensed Professional Engineer, he has had extensive experience in all phases of metal finishing as a foreman, consultant and factory manager in many of the leading plants in the country. He has been a contributor to the technical press for many years, and has carried on a consulting practice for 25 years.

Aluminum hollow ware is generally left in its natural color of either bright or satin, although certain novelty items are given various colored effects by means of anodizing the aluminum, and then treating with dyes.

Reasons for refinishing articles of hollow ware may be many. First, through normal domestic use and cleaning, the articles may have the silver or chromium rubbed off, thus revealing the unsightly appearance of the base metal. On the other hand, especially from restaurants, clubs, and hotels, the hollow ware may show signs of very rough usage, with corners of dishes bent, rims of bowls battered and showing many indentations of various depths. However, if the articles have received fair treatment in use and in refinishing and replating, the finished job should be practically equal to new. On articles that have received rough usage, all defects must be removed by proper mechanical treatment, even to the extent of removing decorative mounts, legs, handles, etc.

Refinishing Operations

With the above outline as to the general problems of refinishing hollow ware, a listing of a tentative series of operations upon a piece of hollow ware received for repair would be in order.

1. Strip plate—whether silver or chromium.
2. Inspect for defects and classify.

CLASS A	CLASS B	CLASS C
No dents—minor scratches only.	Deep scratches and dents, but not on or close to mounts, handles, legs.	Deep scratches and dents close to or on mounts, handles, legs.

3. Class A—Send directly to polishing department.
   Class B—Hammer out dents and deep scratches, then send to polishing dept.
   Class C—Remove mounts.
   Hammer out dents and deep scratches.
   Polish where necessary to permit re-soldering mounts.
   Re-solder mounts.
   Send to polishing department.
4. Polishing department operations.
5. Plating operations.

FOR SILVER	FOR CHROME
Silver strike.	Nickel plate.
Silver plate.	Nickel color.
	Chrome plate.

6. Coloring operations.
7. Inspect.
8. Pack and ship.

Equipment Required

We have now arrived at a point where we can list the equipment and operators a shop must have.

1. A soldering bench (requiring an air compressor, the size of which will depend upon the number of solderers employed), a gas line, torches, rubber hose and other minor requirements. There should be at least one expert solderer, with sufficient mechanical ability to make or repair mounts that require extensive repairs or replacement. If the expert solderer is also capable of doing the necessary "smithing work," so much the better. Otherwise we will require:

2. A smith—called "silversmith" in the trade—an operator who forms or shapes metals with a hammer. Various shapes of anvils and hammers are required.

3. A polishing department in which operations of sand bobbing, polishing, cut down, and coloring can be performed.

4. Plating department equipped to strip plating, perform plating operations, and scratch brushing.

Plating Department

The plating department should consist of five major sections; namely, silver stripping, chromium stripping, silver plating, chromium plating, scratch brushing. Details of the various operations performed in each of these sections follow.

STRIPPING OPERATIONS—
CHROME PLATED PARTS

1. Clean in alkali cleaner (160°—180°F.) to remove surface greases or materials used in household cleaning.
2. Rinse in hot water.
3. Strip chromium and nickel. In a 50 gallon ceramic jar make up a concentrated sulphuric acid strip by placing one gallon of glycerine in the jar. Then add concentrated sulphuric acid, stirring in the first few gallons of sulphuric acid with the glycerine. The work to be stripped is made the anode. The cathode is a sheet of lead shaped closely to the inside of the jar, and securely fastened to the negative lead. A throw switch to complete the circuit, when the article is in the strip, and to break the circuit before removing from the strip, is essential, as otherwise a serious explosion may occur from any spark that may occur, as a copious volume of hydrogen gas is evolved during stripping. The stripping operation is carried on, reverse current, at 6 volts.
4. Rinse in warm water.
5. Rinse in hot water to dry.

An alternative strip would consist of a 20% by volume of hydrochloric acid. The articles to be stripped are placed in this solution until the chromium is removed, then rinsed in warm water, and hot water to dry. In this strip, the nickel will not be removed, but can be removed as explained later under polishing department operations. The stripped articles are then sent to the Inspection Bench for defects classification.

STRIPPING OPERATIONS—SILVER-PLATED PARTS
HAVING A COPPER ALLOY BASE

1. Clean in alkali cleaner (160°—180°F.) to remove greases and household cleaning materials.
2. Rinse in hot water.
3. Immerse in stripping solution made up in the following proportions.

Nitric Acid	2 gallons
Sulphuric Acid	4 gallons

This strip should be made up in a rectangular ceramic tank large enough to handle the volume of work received, and set in a tank of hot water maintained at a temperature 180°—190°F. The articles to be stripped are wired or racked and placed into the strip. Remove from the strip in 3 to 5 minutes for the purpose of observing how much of the silver has been removed. Return to the strip, if necessary, and leave in the strip as long as necessary. The operation must be carefully watched by repeatedly lifting the article from the strip until practically all the silver and nickel have been removed. Particularly when a large quantity of articles have to be stripped at one time, and the thickness of silver varies on the different articles, each has to be separately examined, removing those from the action of the strip as soon as they show evidence that the stripping has proceded as far as it can be practically carried out.

In the stripping operation, salts will settle out and sludge will form on the bottom of the stripping tank. Care should be exercised so that the lower part of the articles does not become imbedded in the sludge.

4. Rinse in warm water.
5. Rinse in hot water to dry.

Stripping Operations—Silver-Plated Britannia Metal or Pewter

1. Clean in alkali cleaner (160°—180°F.) to remove grease and household cleaning materials.
2. Rinse in warm water.
3. Strip in a reverse current cyanide solution consisting of 8 ozs. sodium cyanide per gallon at 6 volts. The cathode should be pieces of steel. In stripping Britannia Metal and pewter, the operation is facilitated by removing the articles from the cyanide strip, scratch brushing with a soft scratch brush, and then returning to the cyanide strip.
4. Rinse in warm water.
5. Rinse in hot water to dry.

A much cleaner and uniform job of stripping silver in the cyanide reverse strip can be obtained if the unit is equipped with a reverse periodic plating unit, with the unit set at 8 seconds reverse and 2 seconds direct.

Articles are then sent to the inspection bench for classification and possible repair.

In re-plating tea and coffee pots, cocktail shakers, sugars and creamers, after stripping the silver or chromium from them it is the best practice to heavily scour with pumice and water the inside of these articles, to insure that the inside of these articles are in a satisfactory condition for re-plating.

Pre-Plate Cleaning—Copper Base Alloys

The hollow ware articles when received from the polishing department should be in the same condition as when originally manufactured. The usual method of preparing these articles in the trade is to:

1. Alkali soak and mop entire area with a plater's mop.
2. Scratch brush borders and other lead attachments with pumiced soap-bark water to remove imbedded polishing materials. This brushing operation involves the necessity of several scourers depending upon the production requirements, and consequently is an expensive operation.

Recent improvements in cleaning methods have shown that the brushing operation is unnecessary, if the articles are first soaked in an emulsion cleaner. A suitable sequence of cleaning operations is as follows:

1. Soak in Emulsion Cleaner—140° F. for 5 minutes. Mop off surfaces.
2. Two hot water rinses.
3. 1st Electric Cleaner (2-2½ oz./gal. sodium hydroxide) cathodic, 170°-180° F., 6 volts, 30-45 secs.
4. Hot water rinse. At this point articles requiring internal scouring are given that treatment with pumice and water.
5. 2nd Electric Cleaner (2-2½ oz./gal. sodium hydroxide) cathodic, 170°-180° F., 6 volts, 30-45 secs.
6. Two cold water rinses.
7. Hot cyanide electric clean (2 oz./gal. sodium cyanide) cathodic, 140°-150° F., 6 volts 45-60 secs.
8. Cold water rinse.
9. Copper strike 120°-130° F., 3-4 volts, 45-60 secs.
10. Two cold water rinses.

Silver Plating

After the above cleaning cycle, parts for silver plating are carried through the following steps:

12. Two cold water rinses.
13. Silver Strike.
14. Silver Plate—time to desired weight of silver.

The silver plated work after being removed from the tank has the bottoms scratch brushed with a medium hard brush to a clear satin finish; the inside of dishes are Butler finished. The border mounts, handle and leg attachments are scratch brushed to remove the silver matte with a very soft scratch brush in order to make them easier to color, as are also all surfaces hard to get at with a coloring wheel, in order that the danger of cutting through such surfaces be minimized.

Chromium Plating

The following steps are recommended for chrome finishing articles after the pre-clean steps listed (1-10) above.

11a. Nickel Plate 20 minutes.
12a. Cold water rinse, then hot water rinse.
13a. Nickel color.
14a. Electric Clean, cathodic at 6 volts, 180°-190°, 30 secs.
15a. Cold water rinse.
16a. Acid dip—3% sulphuric acid, 10-15 secs.
17a. Cold water rinse.
18a. Chromium plate.
19a. Dragout rinse.
20a. Cold water rinse.
21a. Hot water to dry.

The chromium plated articles should be ready for packing and shipping, with the exception that some pieces slightly cloudy may require a color buffing.

Solutions Required

Solutions used for plating hollow ware may be any standard solutions operated under those conditions giving the plater the best results to his satisfaction. The writer prefers the following:

Copper Strike

Sodium cyanide	5	oz./gal.
Sodium carbonate	2	"
Rochelle Salts	6	"
Copper Cyanide	3.5	"
pH	11.00-12.00	

This solution is maintained at 0.75-1.0 oz. free sodium cyanide per gallon.

Nickel Solution

Single nickel salts	20	oz./gal.
Nickel chloride	4	"
Boric Acid	2½	"
pH	5.6-5.8	
Voltage	2	
Temp. (minimum)	72°F.	

Silver Strike

Free Sodium Cyanide	8-10	oz./gal.
Silver Cyanide	0.50- 0.75	"

Chromium Solution

Chromic acid	53	oz./gal.
Sulphate	0.53	"
Temperature	100°-125°F.	
Current Density	125 amps./sq. ft.	
Voltage	5	

Cleaning and Plating—Britannia and Pewter

Articles of hollow ware made of Britannia Metal and pewter can be successfully treated with the same series of operations listed above, the only precaution required being that, in cleaning, the time cycles have to be performed with more rapidity, care, and attention.

Polishing Department

For hollow ware the polishing department is not much different from that of any other polishing department, except in one major respect, and in a few minor ones. One of the minor ones is in the type of lathes. The spindles for hollow ware must be long so that large trays may be handled without knocking them against the lathe frame. This requires that the lathes be of much heavier and sturdier construction than those required on smaller works. Another minor aspect is that, in working on hollow ware, the amount of transportation of the work from and to the polishing department is greater, prior to the final coloring, before being ready for plating.

The major difference in a hollow ware polishing department lies in the fact that a hollow ware polishing department must contain a sand bobbing section. Sand bobbing is used to smooth the surfaces of hollow ware, and particularly those of sterling, Britannia Metal and pewter. Regular polishing and cut down operations would never produce the surface that is required for goods of this nature.

The wheels used are cut out of walrus hide and bull's neck. They are turned to shape by the operator. The abrasive used is ground pumice, moistened with lard or machine oil. The work is grasped in one hand, while the other hand scoops up the abrasive and slowly feeds it between the work and the wheel. This operation requires a highly skilled operator. The net result of the sand bobbing operation is a fine, smooth, polished effect that could only be obtained on a flat surface with four or five wheel-polishing operations, and on hollow ware such operations would be impossible.

Sand buffing is similar to sand bobbing, except that the buffs are made from sheep skin or cotton discs sewed together. In order to obtain a better cutting surface, the buff is charged with ordinary brown laundry soap at short intervals, providing a temporary bond for the absive. After sand bobbing, the regular cut down operation is performed, followed by all the other operations in sequence as required.

Stripping Old Coatings Mechanically

The sand bobbing and sand buffing operations can be substituted for the stripping operations very economically. In actual operation they are preferred by the writer, first as being less messy, and second as being just as economical. First it must be remembered that if a first class repair job is to be done every piece, even after stripping, has to be sand bobbed to remove the smallest of scratches.

Handling the work in this manner, the operations would be as follows, in the plating department:

1. Clean in hot alkali cleaner.
2. Rinse in warm water.
3. Dip in hot (110°-120°F.) sodium cyanide solution (4-6 oz./gal.) to remove tarnish and oxidation.
4. Rinse in warm water.
5. Rinse in hot water to dry. Work is ready for sand bobbing.

By setting up a special sand bobbing box for handling the hollow ware, the silver removed can be kept concentrated for sending to the refiner. After removing the silver by sand bobbing, the work is sent to the Inspection Bench. Work that had only minor scratches will generally be found to be ready for the balance of the polishing department operations, while, those pieces requiring "smithing" work will be in a much more acceptable condition for the performance of the smithing. After smithing, they will require only a slight sand bobbing touch upon those spots that were hammered.

Remarks

In writing this article, the writer has endeavored to cover all the important operational factors. Other important factors entering into the refinishing of hollow ware are the removal of monograms; maintaining a stock of standard mounts and findings to replace those that cannot be repaired; methods of determining amounts of silver deposited; reclamation of silver from strips, and proper handling of rinse waters for the reclamation of silver therefrom.

Electrolytic Polishing of Metallic Surfaces—Part II

By Dr. Pierre A. Jacquet, *Ingénieur-Chimiste I.C.P., Docteur de l'Université de Paris, France.*

Generalities on Electrolytic Polishing Methods

THE reader will find a complete list of original publications describing in detail the various laboratory techniques of electrolytic polishing in the attached bibliography[13]. Typical industrial processes are made the object of special descriptions, usually in the form of patents, but a certain secrecy surrounds the realization of the technical details (installation of the cells, exact functioning conditions, control of the composition of the baths during operation, etc.). For this reason we will consider the generalities which apply to the laboratory polishing of specimens. A following article reserved for industrial applications of electrolytic polishing will contain the essential known generalities on the factory processes.

Preparation of Metallographic Samples

In general, the operator is usually interested in the electrolytic polishing of a surface which has previously received a chemical or mechanical treatment conferring to it a specific property and a surface which is not too rough. Also, thick crusts of oxide or grease films have been removed by pickling or degreasing according to conventional methods. The mechanical roughing-down operation with abrasives should be carried far enough to reduce the time required for electrolysis to an acceptable time. This initial condition of the surface should depend to a large extent upon the metal and especially upon the electrolytic method used. This is the case for the polishing of zinc and magnesium in phosphoric acid-alcohol; the rate of solution is very slow, thus the surface submitted for polishing should be well prepared (for example even with 000 or 0000 sandpaper).

On the contrary, the polishing methods for steel developed by *Kuhn*[14], *DeSy*[15], and more or less modified later by other investigators[16], allows the polishing of surfaces, roughly prepared by filing or by grinding, in a few seconds under a high current density. The intermediate cases between the two extremes are the general case: with copper and its alloys polished in a phosphoric medium; steel, aluminum, tin, lead, etc., all polished in a perchloric-acetic bath, the mechanical preparation is stopped with 00 or 000 paper coated with paraffin.

Mounting the Sample

The specimen, prepared as indicated above, is fixed in a mounting which will allow suspension in an electrolyte and which will assure perfect electrical contact. Several types of metal or plastic clamps have been described for this purpose[17]. Among the plastics which are suitable are methyl methacrylate for phosphoric acid baths, and polystyrene for mixtures of perchloric and acetic acid. With the insulating clamps, the electrical contact is established by pressure against a small platinum disc or point. For mounting specimens of complex form or very large dimensions for complete polishing, the contact is made from the same metal as the sample. The use of solder to establish contact is generally not advisable, especially when it is not protected from the bath by an insulating varnish.

Partial polishing of a piece is possible by protecting all of the areas which are not to be polished with a varnish (chlorinated rubber, for example).

Certain polishing techniques do not necessitate mounting the sample in a clamp or conducting filament. These are the methods derived from those of DeSy, at high currents. Also, *Lowgren and Hildebrand* simply placed the piece upon a metallic plate connected to the positive pole of the current source. In commercial polishing equipment (*Buehler, Cenco,* etc.)[18] the piece is placed against an orifice, pierced in an insulating plate, by means of a spring, and the plate is placed at the upper part of the side of the electroly-

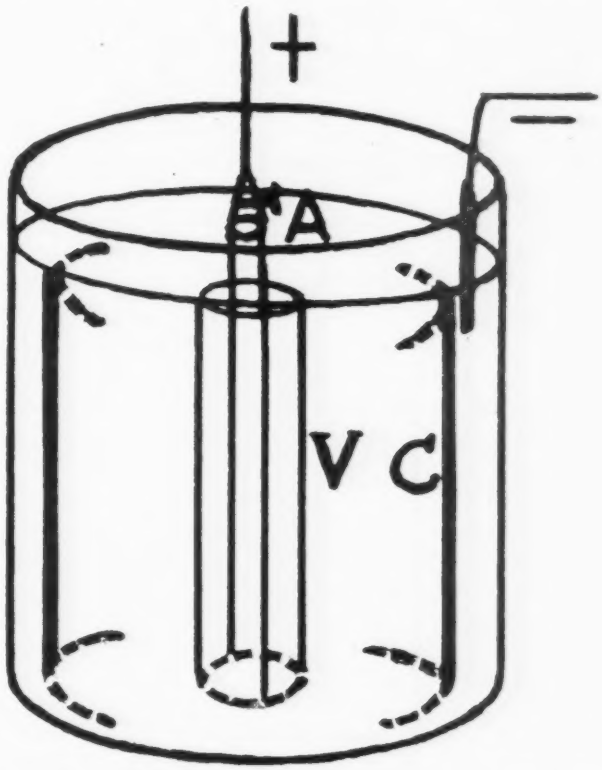


Figure 4. Simple electrolytic cell for study of polishing conditions.
A—Rod of metal to be polished.
C—Circular cathode of nickel.
V—Glass tube surrounding the anode for part of its height.

tic cell. Such arrangements require samples of well defined shape and form, and are not useful for the polishing of pieces over all of their surfaces. The same holds for the apparatus of *Knuth-Winterfeldt*[19] with which the polishing is localized to a 1 mm² area of the surface.

The Electrolytes

Although there are now a sufficiently large number of laboratory and shop processes for polishing common metals and alloys, the basic constituents of the electrolytes are limited to a few chemical products: perchloric, phosphoric, sulfuric, nitric, chromic, acetic and citric acids; acetic anhydride; sodium hydroxide, potassium hydroxide; methyl, ethyl, and amyl alcohols and their ethers; and glycerine. Some rare techniques use salts such as cyanides, nitrates, borates, sodium hyposulfate, aluminum chloride and zinc chloride[20]. In general, all of the electrolytes are characterized by a high concentration of one or more acids or bases in an ionizing medium such as water or an organic liquid.

The preparation of the baths whose exact composition is given in the literature does not offer any difficulties, with the exception of mixtures of acetic anhydride with aqueous perchloric acid, nitric acid or chromic acid, since the reaction of the acetic anhydride with the water in the acid causes a vigorous evolution of heat. These reagents should be prepared by mixing the components slowly in a cooled vessel. One may easily build equipment which allows mixing of the reagents without the necessity of special supervision.[21]

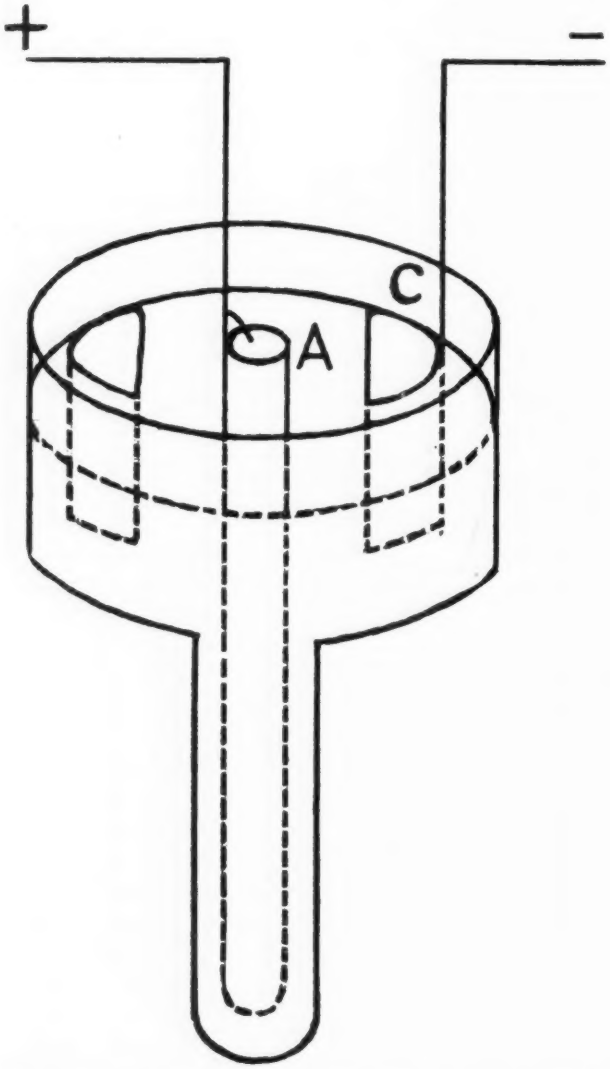


Figure 5. Another cell for electropolishing studies. This model allows easy temperature maintenance and observation of the anode during operation.

Many metallographers hesitate to use polishing baths containing perchloric acid. However, equipment has been installed in the United States, France and Germany which allows the use of quite large volumes of this type of electrolyte. The serious accident in Los Angeles which destroyed a factory in February 1947, in which an aluminum polishing tank of 1,000 liters capacity was in operation (composed of 70 volumes of 72% perchloric acid and 30 volumes of acetic anhydride), confirms the dangers of such mixtures.[22] In a later article to appear in Metal Finishing, the author will reveal the results of a study of the explosive properties of aceto-perchloric acid baths. We are able to say now, that the mixtures which contain less than 50% perchloric acid are not explosive. The causes for the Los Angeles explosion were essentially:

a). The lack of knowledge by the so-called inventor of the process.

b). The much too high concentration of perchloric acid.

c). The excessive heating of the bath as a result of a failure in the refrigeration system.

d). The presence of a plastic (cellulose acetate-butyrate) in contact with the hot bath.

The author and numerous other investigators have used daily, for more than ten years, polishing baths of perchloric acid and acetic anhydride without ever having seen the least explosion even when departing appreciably from the normal conditions of operation (large elevations of temperature, sparking above the bath, etc.). The only risk is fire, for baths sufficiently concentrated in acetic anhydride are inflammable on contact with flame.

Contrary to what one might think, polishing baths composed of perchloric acid and ethyl alcohol are not explosive, according to their inventors. Ethyl perchlorate is a violent explosive, but the concentration of acid in electropolishing baths is too weak to form this explosive compound in an appreciable quantity[23]. One should only avoid heating used baths of this type to boiling, for example, for recovery of the alcohol. However, the Germans have reported the explosion of a bath containing perchloric acid and an alcohol in the course of electrolysis[24].

The Conditions of Electrolysis

Those investigators who wish to learn the techniques of electrolytic polishing are always, it seems, under the impression that the conditions of electrolysis and also the composition of the bath depend upon the purest empiricism. Up to a certain point this opinion

is well based, for the simple reason that knowledge of the mechanism of the polishing effect is still ignored. However, we have previously given a certain number of facts which partially clarify the possible mechanisms and which may serve as a guide to systematic research. To further explain these ideas, and show their practical importance we will present certain useful data later under the title "Research on Polishing Conditions." For the present it will suffice to review the essential functioning characteristics of the known and proven baths.

Electrical Conditions

From the point of view of the optimum limits of the anodic current density the actual electrolytes are divided largely into three classes:

1) Those that work at very low current densities, between 1 and 15 A/dm² (10—140 A/ft²). In this category are:
   —Mixtures of aqueous phosphoric acid in alcohol or glycerine (for polishing copper, brass, zinc, cadmium, stainless steel, magnesium and cobalt).
   —perchloric-acetic mixtures (for aluminum, iron, steel, lead and tin).
   —alkaline baths based on caustic soda, or sodium or potassium cyanide baths (used for the polishing of tungsten, cadmium, zinc and silver).

For all of these electrolytes the voltage at the source of the current is between a few volts and 40 volts.

2) The industrial baths whose principal constituents are phosphoric, sulfuric, chromic and citric acids. These require current densities between 15 and 150 A/dm² (140—1400 A/ft²), the optimum value being a function of the composition, the temperature and the nature of the metal to be polished. The voltage at the source is generally 15 to 25 volts but sometimes reaches 60 volts.

3) The baths used only in the laboratory, based upon low concentration of perchloric acid in ethyl or methyl alcohol, with the occasional addition of glycerine. These are the electrolytes which allow the polishing of very small surfaces in a very few seconds under very high current densities, that is 200 to 400 A/dm² (1860—3720 A/ft²) and even as high as 3000 A/dm² (28000 A/ft²). These mixtures, being poor conductors, require a direct current source of 110—220 volts.

In reality this division of the electrolytes into three classes is quite arbitrary. For example, aqueous phosphoric acid baths allow polishing of copper at 50—100 A/dm² (465—930 A/ft²). It is the same for the perchloric-acetic baths for the polishing of aluminum: a modification of the technique consists of establishing a potential of 160 volts at the terminals of the cells (in place of the 25 volts in the original process), before introducing the specimen.[25]

Arrangement and Form of The Electrodes

Polishing is generally produced over all of the surface of the anode whatever its shape *when the condition of the minimum current density is established at all points.* A vertical position of the anode is understood to be the most normal, but it is a case where it is not the most favorable, since it causes a downward flow of the viscous film which results in striations, and it favors the anchorage of bubbles of anodic or cathodic gas. Thus, to polish copper or brass in phosphoric acid media, the small specimen is placed horizontally, opposite the cathode, which is also horizontally placed above the face of the sample to be polished. The same arrangement is also necessary to polish zinc in an alkaline bath.

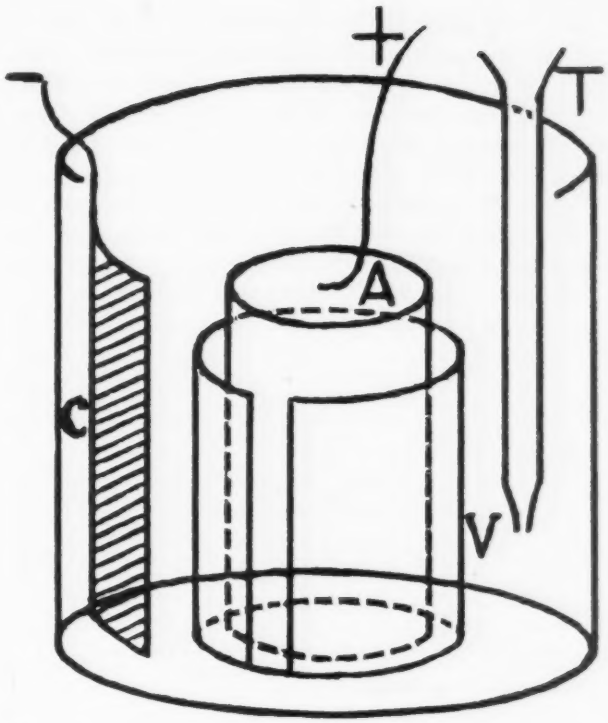


Figure 6. Another type of electropolishing cell which permits the study of the time factor.
A—Rod of metal being polished.
C—Flat cathode.
T—Glass tube for gradual introduction of electrolyte.
V—Glass cylinder having a bottom base and lateral slit.

With the method of DeSy, the piece of steel or light alloy is also in a horizontal position but only a few millimeters are immersed in the bath and the face to be polished is turned toward the bottom, opposite the cathode, which is placed about ten centimeters away.

The disadvantage of the techniques requiring a horizontal position of the anode is the impossibility of polishing all parts of the sample simultaneously.

In general, the surface area of the cathode should be several times that of the surface area of the anode to be polished. The nature of the cathode does not have any effect provided that it is composed of a metal or alloy not attacked by the constituents of the bath. In phosphoric acid, copper works well. For all of the other baths the cathode is stainless steel, nickel, or sometimes aluminum.

A very particular arrangement of the electrodes is presented in a new technique called brush or disc polishing[26] ("electrolytic lapping") proposed for the

electrolytic micrographic polishing of a part or all of massive pieces, and eventually applicable industrially to the polishing of tapes and wires and to the removal of oxides from the surfaces of welded pieces. In the brush method the cathode is composed of a metal mass, the end of which is covered with a tissue of glass fibres soaked in an electrolyte, and which is moved and passed lightly over the surface of the piece connected to the positive pole of the source.

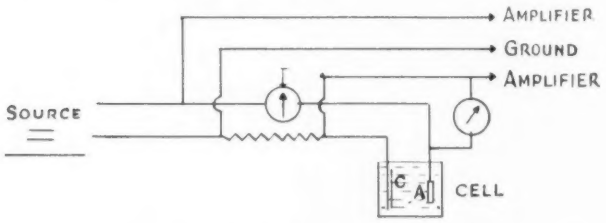


Figure 7. Schematic wiring diagram for connecting an oscillograph and instruments to a polishing cell for tracing the Current-Voltage curve.

A—Anode.
C—Cathode.
I—Ammeter.
R—Resistance (1-5 Ohms).
V—Voltmeter.

Polishing on a disc (lapping method) depends upon the same principle but it is the anode which moves softly over the cathode which is composed of a conducting disc covered with glass cloth containing the polishing solution.

Finally, it is sometimes advantageous to make the anode turn in the solution, for this adds a little to the current density usable and assists in cooling the layer of electrolyte in contact with the surface.[28]

Temperature

Most of the polishing baths used in the laboratory operate at room temperature. The maintenance of temperatures around 20°C does not offer any difficulty for good conducting electrolytes which do not need an elevated current density. On the contrary, an adequate cooling system is necessary with perchloric-acetic or perchloric-alcohol baths where the heating is due to the liquid film around the anode and the elevated current density. The appreciable heating of the surface is easy to demonstrate: when it leaves the bath, a piece which has been treated for a few minutes easily reaches 40° to 50° C, while a thermometer placed in the liquid shows only 25° C. The temperature reached in the course of the regular electrolysis is still higher. This may be very simply determined either by a thermocouple, or more simply by surrounding a thermometer bulb with a metal foil which acts as the anode. With aluminum in a perchloric-acetic bath we have observed temperatures of 60° to 70° C. with the bath showing 22° C. The thermocouple method used at K.W.I. of Stuggart[27] has given similar results in the case of steel in perchloric-acetic mixture: 53° C. under 8 A/dm² (75 A/ft²), and 75° C. under 22 A/dm² (205 A/ft²), the temperature of the bath never exceeding 18° C. in the first case and 22° C. in the latter. This appreciable difference in the temperature of the anode and the bath shows very well that the heating is localized on the surface of the anode and that it is transferred to the interior of the metal by virtue of its better thermal conductivity as compared to that of the liquid.

This thermal effect at the surface of the anode is important to consider when the polishing has as its goal the preparation of the surface for micrography or for certain physical chemical studies, for the superficial heating might cause structural modifications such as the recrystallization of a cold-worked surface.

Naturally the heating of the object is not to be feared when the method of polishing is not complicated by the formation of an anodic layer of high resistance. In all of the other cases efficient refrigeration is necessary in order to remain within the limits compatible with good polishing.

The heating effect localized on the anode makes it difficult to determine the conditions of electrolysis precisely, for it is necessary to maintain a relationship between the current density and the temperature. Thus the troublesome corrosion which is sometimes produced when the current density passes a critical value is perhaps due to a disturbance produced by an exaggerated elevation of the temperature, and not to a change in the fundamental anodic processes.

The fact that the thermal effect is localized at the interface of the metal and solution complicates the problem of refrigeration. If the dimensions of the anode are small a bath of water circulating about the cell should be sufficient. For much larger surfaces one must use a bath of much larger volume, cooled by interior circulation of cold water through coils. Agitation of the liquid, if compatible with satisfactory polishing, also serves to level the temperature. Good results are sometimes obtained by rotating the anode in the electrolyte. A recent article describes polishing aluminum and cadmium using this principle, the optimum speed of rotation being about 350 revolutions per minute.[28] In phosphoric acid media, motion of cadmium anodes allows the use of a higher current density and reduces the polishing time. This phenomenon is not observed in the polishing of aluminum in a perchloric-acetic bath, but rotation of the anode reduces considerably the undesirable corrosion caused by the elevations in temperature.

FIGURE 8

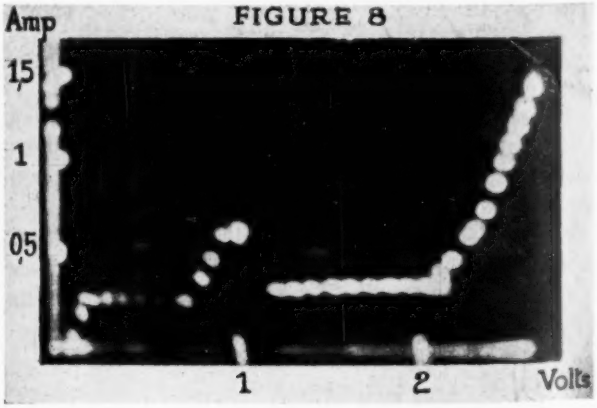


Figure 8. Current-Voltage curve traced automatically by photographing a spot on the Cathode tube of the oscillograph.

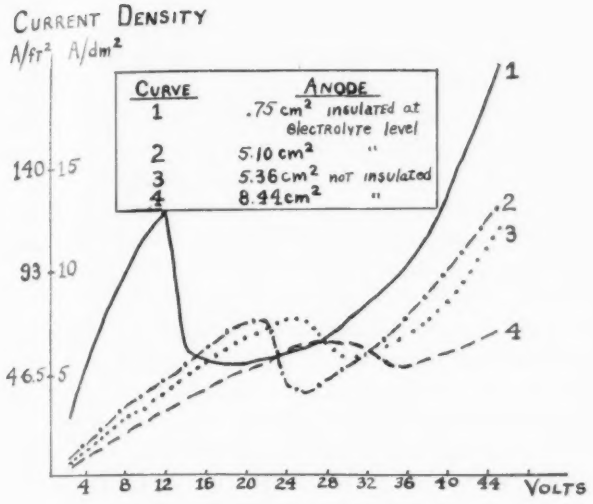


Figure 9. Influence of the surface area of the anode on the Current-Voltage, I-f(V) curve. Steel anode previously smoothed with No. 0 emery paper. The insulation of the anode at the level of the electrolyte has an important effect, as shown by curves 2 and 3.

In practice, if the thermal effects are without effect upon the structure of the test pieces, perchloric-acetic and perchloric-alcohol electrolytes give good polishing at a maximum temperature of 30° C. (measured a few centimeters from the anode), but with these electrolytes, especially with iron and steel, one should also consider a minimum temperature of operation, since at below 15° C. these are covered with a solid crust of the solution products when the current is started, which is apt to produce serious etching.

To our knowledge there is only one case where strong cooling of the electrolyte is recommended; this is the case of magnesium in a bath of perchloric acid and the monoethyl ether of ethylene glycol ("Cellosolve"), for above 10° C. and in the absence of a current this mixture vigorously attacks magnesium.

Quite the contrary, certain electrolytes only give good results at temperatures between 40° and 100° C. and even higher. These are the industrial baths rich in phosphoric acid with additional sulfuric or chromic acid. Thanks to the high current density it is easy to maintain temperatures in this range, but the corrosion of the tanks and the accessories presents some problems of equipment.

Agitation

Aside from a favorable effect in the cooling of the bath, agitation is not generally indispensable. In laboratory electrolytes based on perchloric acid it is possible to detect traces of flow of the viscous film which appear after the electrolysis has been carried out for a few minutes. This agitation should be very slight and is in effect only in that portion of the bath between the anode and the cathode. A more vigorous agitation is to be recommended with the electrolytes of DeSy, and similar ones requiring very high current densities.

Several authors have described methods where the anode is moved by translation or rotation in the middle of the solution.[29] *C. Crussard*[30] has devised a system which comprises turning, not the anode, but the cylindrical cathode which has been placed around the object to be polished, and this cathode is pierced with holes simulating fixed paddles. This arrangement, which assures a continuous renewal of the liquid in the vicinity of the anode, is claimed to be very efficient for the polishing of cylindrical samples which must rigorously maintain their regular form.

Some commercial equipment for the rapid polishing of small surfaces contains a pump for the rapid circulation of the solution.

Agitation by blowing in compressed air, moving the pieces or by pumping the liquid is used in nearly all of the industrial installations. The two former methods, which are used in polishing for decorative purposes, aim toward the removal of the bubbles of gas which form and have a tendency to adhere to the anodes. The American method prefers to move the bar from which the pieces are suspended through a distance of fifteen centimeters (6 inches) at the rate of about 20 to 30 cycles per minute. In France, the circulation of the bath for electrolytic superfinishing is accomplished by pumps of high output and generally constructed of aluminum. Rapid circulation is indispensable here for cooling the zone of liquid around the piece, for it is subjected to a high current density, about 200 A/dm² (1860 A/ft²). In their semi-industrial installations for electrolytic polishing of steel armament, the Germans also used circulation of the electrolyte of perchloric acid and acetic anhydride by pump.[27]

Duration of Electrolysis

The time of electrolysis necessary to give good polishing varies with the metal, the initial state of the surface and the method used. For scientific applications of electrolytic polishing it often is of interest to know quite precisely the rate of anodic solution under the conditions of the experiement, for one should not forget that the elimination of the lines caused by the mechanical finishing does not necessarily imply the

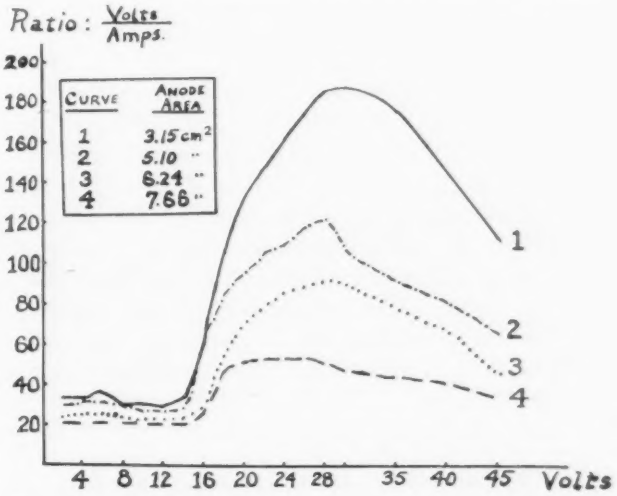


Figure 10. Influence of the surface area of the anode on the V/I-f(V) curve. Steel anode previously polished with No. 0 emery paper. The maximum of the V/I ratio becomes greater as the surface area of the anode becomes smaller.

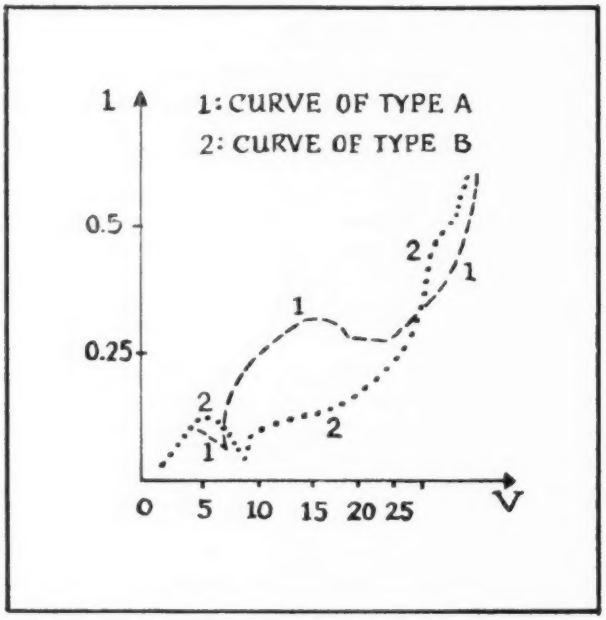


Figure 11. Current-Voltage curve recorded by the oscillograph with a steel anode in an Acetic-Perchloric bath, showing the effect of the micro-geometric state of the surface. Curve 1 is a curve obtained with a No. 0 emery paper surface, curve 2 with a previously electropolished surface.

total solution of the zones effected by the cold working.

With laboratory baths working at moderate current densities (phosphoric acid and mixtures of acetic and perchloric acid) the surface subject to electrolysis is generally prepared by abrasion with number 00 or 000 emery paper. The polishing is then further carried out in a perchloric acid bath (5—7 minutes for steel, aluminum, lead, tin, etc.), or in a phosphoric acid bath (30 minutes for copper and brass and 45—60 minutes for zinc and magnesium).

Certain anodic processes are characterized by an extreme rapidity and only necessitate a rough mechanical preparation (number 1 emery paper or even filing). Very small samples are thus polished for microscopic examination in a few seconds (the methods of *Kuhn*, *DeSy-Haemers*, *Knuth-Winterfeldt*, etc.).

Treatment of the Surfaces After Electrolytic Polishing

Two cases are to be considered, depending upon whether the objects submitted to electrolytic polishing are destined for laboratory studies or for technical applications.

Laboratory samples are removed from the bath after a preliminary drop in the current, except if attack of the surface by the electrolyte is to be feared, in which case the anode is removed under current (examples: certain steels, tin and lead in acetic-perchloric mixtures). The piece is immediately washed under a vigorous stream of water in order to remove the entrained viscous liquid layer. Sometimes it is necessary to rub the surface very lightly at the same time with a piece of cotton in order to remove a very thin solid film (in the case of certain alloys of tin and antimony and light alloys of silicon). It is recommended that these objects be rinsed in a limited volume of water. The first wash should sometimes be followed by immersion in a dilute acid (phosphoric, acetic, hydrofluoric) to dissolve a thin solid film formed by the reaction of the water with the entrained viscous film of electrolyte (this is produced especially if the wash water contains much calcium salt). To avoid this inconvenience the washing should be done with distilled water. It is followed by rinsing in pure ethyl alcohol and then by proper drying in a stream of warm air.

Some metals require more precautions. Magnesium is attacked very quickly by water, and the alloys of aluminum and magnesium washed for a long time may show microscopic pitting. One should then reduce to a minimum the time of contact with water. The treatment of samples for certain studies, such as the measure of the potential of solution or for electron diffraction diagrams, requires particular attention, since these techniques are extremely sensitive to superficial contamination of the metal. To avoid possible oxidation the use of water is avoided, and the wash as the piece is removed from the bath is made with an organic liquid such as alcohol or acetone.

In general, the polished surfaces are excellently preserved, in that the brilliance remains for a long time in ordinary atmosphere and nearly indefinitely in dry air. The laboratory samples are preserved by protecting them from dust and acid or alkaline vapors.

For manufactured objects, after electrolytic polishing the pieces are treated according to the processes in use in the electroplating shops; that is, washing first with cold and then with hot water and drying in an oven or with sawdust. With the exception of non-oxidizing steels, which retain their polished state, the majority of electrolytically polished objects are later subjected to other chemical or electrolytic treatments. It is then that aluminum and its alloys are anodically oxidized in sulfuric or oxalic acid baths; iron, steel, copper, brass, etc., receive a plating of nickel, chromium, lead, etc. Anodic oxidation immediately follows polishing after a simple rinsing with water, but nickel, chrome or lead plating necessitate the correct execution of a supplementary treatment of "activation" or depassivation of the polished surface. The aim of this is to dissolve a very thin invisible film which causes poor adhesion of the deposit. The activating baths are acid solutions in which the polished pieces are immersed for a very short time so as not to destroy the polish.[31]

It is important to emphasize that the water used to wash the polished objects should not be too high in content of calcium salts. A conveniently purified water should be given preference.[32]

Principles of the Methods of Determining the Polishing Conditions

Until a relatively recent date, the determination of the exact conditions for anodic polishing were purely empirical, for the operator had little data for the prediction of these conditions. Research has made possible the introduction of new electrolytes, of industrial interest as much for reducing the price or

cost of treatment as for the improvement of the results. The scientist is equally interested in such studies, for in adding to his practical knowledge he may expect to discover and explain new phenomena. Inversely, all progress of the theoretical type should involve the perfectioning of techniques and economics of electrolytic polishing. *F. Bertein*[33] conceived the first of the models of electrolytic cells which allowed simultaneous investigation of a large range of anodic current densities, a factor which is known to be of fundamental importance in polishing. Figure 4, 5 and 6 show the principle arrangements adopted. That in Figure 4 contains a beaker in which a foil of nickel applied to the inside of the wall constitutes the cathode C. The anode A is a rod of the metal to be studied, arranged along the axis of the cell. A glass tube V surrounds part of this rod near the base and it is placed as exactly as possible upon the bottom of the beaker. This tube also plays the role of a screen, or it serves to reduce the highs and lows of current density on the anodic rod. By supplying a fixed current to the cell the anode becomes divided into zones which are of regularly varying electrical characteristics. Inspection of the metal rod after a reasonable duration of electrolysis therefore, shows whether the bath used is apt to give polishing. In the affirmative, judging from the position of the polished region, a good approximation of the current density required can be made: it becomes lower as the polished part is found closer to the bottom of the cell. On the other hand the length of the polished region indicates the region of potential-current relationship corresponding to polishing effects. If this region is a very narrow ring, anodic treatment will necessitate a very narrow control of the electrical factors. One may thus compare rapidly baths of different compositions.

A simple calculation shows that with this arrangement, and a tube 3 cm. long around the anode at a distance of 5 mm., a single experiment of 2 to 3 minutes duration allows the exploration of a range of current densities varying in the order of 1 to 200, such as values including 0.020 and 4 A/cm^2.

The arrangement schematically represented by Figure 5 has the additional advantage of allowing observation of the anode during the passage of the current. Refrigeration of the electrolyte in this case is more easily accomplished.

Finally, the cell shown in Figure 6 allows regular variation of the level of the bath, thus obtaining indications of the time factor.

The information furnished by these types of polishing cells, although purely qualitative, reduces greatly the amount of work necessary in a bath of a given composition. More precise data would be easily obtained by measuring the anode potential at different levels on the anode by means of a probe.

Precise Definition of the Polishing Conditions by Means of the Current-Voltage Curve

We have already mentioned that the anodic solution of copper in a phosphoric acid bath leads to a very specific current-voltage curve, and that polishing of the metal is only possible in certain regions of this curve. The same statement has been made for other metals and different electrolytes, such as zinc in phosphoric or soda media, magnesium in phosphoric-alcohol media, and tungsten in alkaline baths. However, some investigators, not being able to observe this type of curve in all of the known cases of polishing, have denied that it is characteristic of the phenomenon.

Two French authors, *I. Epelboim* and *C. Chalin*[34], have recently had the honor to contribute fundamental information on the $I = f(V)$ relationship in polishing electrolytes. They have shown, in effect, that by means of a few simple experimental precautions, it is always possible to observe a current-voltage curve showing a maximum resistance ($R = V/I$) of the cell with these electrolytes. Polishing of soluble anodes in that case is always in the vicinity of this particular point.

In order to precisely and rapidly trace the current-voltage curve, Epelboim and Chalin used an electronic arrangement composed of two amplifiers of continuous voltage. By introducing an ammeter and voltmeter into the circuit (Figure 7) one may control the exact values of I and V. The two curves thus obtained are identical, but the electrical set up is of much interest since it provides an instantaneous and automatic record of the values. The oscillogram (Figure 8) shows an example of such a recording made with an anode of copper in a bath of orthophosphoric acid. In this one may recognize the five characteristic branches which were interpreted earlier in the article.

It is easy to determine graphically the point corresponding to the maximum value of the ratio $R = V/I$ on the curve $I = f(V)$ by drawing a tangent from the origin of the coordinates: for copper this point corresponds to the end of the plateau of current. Similar records have been obtained with metals which were polished in electrolytes containing perchloric acid and acetic anhydride, such as Armco iron, steels, aluminum, lead, nickel, nickel-rich magnetic alloys, etc. However, the current-voltage curve rarely shows a plateau of current as sharp as that observed with copper and orthophosphoric acid, but it always contains a specific point corresponding to the maximum of V/I ratio. It is the same for several industrial polishing electrolytes.

It is interesting to discuss the physical significance of these results. As we have already mentioned, the shape of the current-voltage curve is characteristic of anodic processes, for starting with a relatively low value of the potential at the terminals of the cell, the cathodic processes (liberation of gaseous hydrogen) does not interfere. In the same way, the potential drop in the mass of the electrolyte is constant if the temperature does not change. Consequently, all observed variations are uniquely dependent upon reactions at the electrolyte-metal interface. It is the viscous layer containing a high concentration of the anodic decomposition products which introduces the supplementary resistance, the maximum value of which marks equilibrium of the processes:

a. solution of the metal
b. diffusion of the solution products into the mass of the electrolyte.

The various electrolytes which are found to give polishing differ by their conductivity proper, and by the maximum which the ratio R = V/I may attain, or in other words the resistance of the viscous layer on the anode at equilibrium. It has been established that the viscous anodic layer formed on iron in mixtures of acetic anhydride and perchloric acid introduces an appreciable electrical resistance. The resistance of this layer at equilibrium, calculated by assuming that its thickness is 0.4 mm*, is 20,000 ohms/cm/cm^2. With an anode of copper in a bath of orthophosphoric acid (530 g/l) the resistance is only in the order of 700 ohms/cm/cm^2.

The extremely high supplementary resistance introduced by the viscous layer formed on iron and other metals in the acetic-perchloric baths consequently causes the temperature rise which we have previously noted. This heating effect has, without doubt, an influence upon the equilibrium conditions, which explains in part the limited stretch of the level of current which is sometimes limited to a simple hook, barely perceptible, in the current-voltage curve.

A certain number of precautions are indispensable in order to trace the curve, I = f(V), under the best conditions. The shape and surface of the anode must be specially considered.[35] It is necessary that the viscous layer surrounding the anode be mechanically stable.

If it is detached from the lower horizontal portions there is a marked diminution in its power to insulate. The resistance of a conductor being inversely proportional to its cross section, the variations of R as a function of V will be best observed with a very short electrode. The curves shown in Figures 9 and 10 show very nicely the influence of the anodic surface on the curve I = f(V) and V/I = f(V) in the case of the polishing of steel in acetic-perchloric electrolytes.

Influence of the Microprofile of the Anode on the Current-Voltage Curve

We have found that the "state of the surface" of the specimen of metal used as the anode when tracing the polishing curve is very important[36]. With a steel whose surface is scored by abrasion with emery paper, one obtains by means of a cathode oscillograph, a curve showing a high maximum of current (curve A Figure 11). If a surface having previously received a very good micropolishing is used (anodic polishing or mechanical polishing with alumina), the curve is quite different (curve B, Figure 11). At first blended with the former curve, it remains later below it, or for the same potential at the terminals the current remains appreciably lower.

This influence of abrasion on the polishing curve may potentially introduce an interesting contribution to the mechanism of the phenomenon. It proves that at equal voltage at the terminals, a surface having an accentuated relief ("peaks and valleys") is subject to a higher current density than that established on a smooth surface. Further, one may say that a very rough surface is appreciably improved after tracing the curve of the first type (A, Figure 11) although it has only been submitted to a very short electrolysis (1 to 1½ minutes). Therefore the first phase of the electrolysis is very efficient for elimination of the irregularities; that is, that the current is concentrated on the ridges, thus their rapid eliminations.

Relationship Between the Current-Voltage Curve and Polishing Conditions

Anodic polishing under electrical conditions of voltage and current which define the maximum value of the voltage, current ratio, have been well observed with metals and electrolytes which give rise to a viscous anodic layer of low enough resistance (copper in an aqueous phosphoric electrolyte, zinc and magnesium in an alcoholic phosphoric electrolyte, and lead in an electrolyte of perchloric acid, acetic anhydride and water). This relationship is only approximate in the cases where the anodic resistance is large, which seems to be due to the disturbing effect of the heating at the metal-solution interface. However, the differences in the quality of the polish obtained by conducting the electrolysis exactly at the maximum of resistance or even a little on one side or the other of this, are not appreciable, and can only be detected with the aid of a microscope. Thus it is only for scientific applications of the surface thus prepared that it is suitable to define exactly the most favorable regions of voltage and current, and the plot of the curve retains all of its interest by contributing precise information.

The metallic ion content of the electrolyte is a factor not to be neglected, for the position of the particular points on the current-voltage curve depend to a certain extent upon a progressive but generally slow modification of the most favorable conditions, as the concentration of the metal in solution is augmented.

Resumé

This first part of our treatise, based upon generalities on the electrolytic polishing process, gives in summary form the actual state of a finishing method for metallic surfaces which is still in the process of evolution. The author, by insisting on certain points, not well known, hopes to stir up laboratory research and the perfecting of more desirable methods.

In a later article, we will examine the numerous scientific and industrial applications already realized or still under study.

Bibliography

1. For a complete review of the patents on electrolytic cleaning, see *S. Tour*, Iron Age, *145*, 23 May 1940, p. 56.
2. Le Matériel Téléphonique (*H. Figour & P. Jacquet*), Brev. franç. No. 707526 (1930).
3. *P. A. Jacquet*, Electrolytic method for obtaining bright copper surfaces, Nature, *135*, 29 June 1935, p. 1076.

* *Value measured experimentally by means of a microscopic arrangement, (unpublished work of the author).*

4. *P. A. Jacquet*, C. R., *201*, 1935, p. 1473; *202*, 1936, p. 402; Trans. Electro-chem. Soc., *69*, 1936, p. 629; Bull. Soc. Chimique Fr., 5 éme Sér., *3*, 1936, p. 705.
5. *P. A. Jacquet*, First Intern. Electrodeposition Conference, London, 1937.
6. *W. C. Elmore*, Physical Rev., *51*, 1937, p. 982.
7. *H. Lowery, H. Wilkinson & D. L. Smare*, Phil. Mag., Ser. 7, *22*, 1936, p. 769.
8. *L. Capdecomme*, Thèse, Paris 1937.
9. *W. C. Elmore*, J. Applied Physics, *10*, 1939, p. 727; *11*, 1940, p. 797.
10. *U. R. Evans*, Discussion on Electrolytic Polishing, Third Intern. Conference on Electrodeposition, London, 1947.
11. *Odier*, Non-published work. See *P. A. Jacquet*, Le polissage Electrolytique des Surfaces métalliques et ses applications, Paris, 1948.
12. *J. Mercadie*, C. R., *221*, 1945, p. 581; *226*, 1948, p. 7519.
13. Principle publications on electrolytic polishing methods. The patents are not cited except when the first known method for a metal is described in the patent.

A. Aluminum and its alloys.
Le Matériel Téléphonique *(H. Figour & P. Jacquet)* Brev. franç. No. 707, 526, (1930).
P. A. Jacquet, C.R., *205*, 1937, p. 1232; The Metallurgist, Suppl. to the Engineer, April 1938, p. 116; Métaux et Corrosion, *13*, 1938, p. 86.
A. L. De Sy & H. Haemers, Stahl u. Eisen, *20*, Feb., 1941, p. 185; Rev. Métallurgie, *38*, 1941, p. 122.
K. Hauffe & R. Tilling, Metallwirtschaft, *20*, 1941, p. 349.
F. Keller, Iron Age, *147*, 9 January, 1941, p. 23.
L. von Hamos, Jernkontorets Ann., *126*, 1942, p. 568.
Anonymous, Aluminum, *24*, 1942, p. 438.
H. C. J. de Decker & A. P. Krijff, Polytech. Weekbl., *37*, 1943, p. 249, 269.
W. Meert, Métaux non Ferreux, *3*, Oct. 1943, p. 3.
P. A. Jacquet, Métaux-Corrosion-Usure, *18*, 1943, p. 198.
Sakae Tajima, J. Central Aeronaut. Res. Inst. (Japan), No. 3, 1944, p. 155.
L. Chamagne, H. Granjon & A. Leroy, Métaux et Corrosion, *21*, 1946, p. 73.
U. R. Evans & D. Whitwham, J. Electrodepositors Tech. Soc., *22*, 1947, p. 24.
L. Richard, Rev. de l'Aluminum, July-August, 1947, p. 234.
J. L. Waisman, Metal Progress, *51*, 1947, p. 606.
J. Mazia, Steel, 19 May, 1947, p. 84.
E. Der Mateosian, Iron Age, 16 Jan., 1947, p. 51.
A. L. De Sy & H. Haemers, Metal Progress, *23*, 1948, p. 368.
J. Farran, Métaux et Corrosion, *23*, 1948, p. 9.
P. A. Jacquet, Journées d'Automne de la Soc. Franç de Métallurgie, Paris, Oct., 1948.

B. Silver.
E. Raub & B. Wullhorst, Mitt. Aus dem Forschungsinstitüt für Edelmetalle, *6*, Nov., 1941, p. 1.
L. I. Gilbertson & O. M. Fortner, Trans. Electrochem. Soc., *81*, 1942, p. 199.
Anonymous, Iron Age, 6 June, 1946, p. 65.
R. Shuttleworth, R. King & B. Chalmers, Metal Treatment, Autumn Issue, 1947, p. 161.
D. R. Turner, Metal Progress, *51*, 1947, p. 970.
D. Gray & S. E. Eaton, Iron Age, 10 April, 1947, p. 64; Metal Finishing, *45*, May, 1947, p. 60; Materials and Methods, August, 1947, p. 78.
D. Gray, 35th Ann. Conv. Amer. Electroplaters Soc., 1948.

C. Cadmium.
E. Raub & B. Wullhorst, Mitt. Aus dem Forshungsinstitüt für Edelmetalle, *6*, Nov., 1941, p. 1.
L. Capdecomme & Y. Schwob, Métaux-Corrosion-Usure, *18*, 1943, p. 173.
J. Liger, Bull. Soc. Chi. Fr., 5 ème Série, *11*, 1944, p. 568.
J. Farran, Métaux et Corrosion, *23*, 1948, p. 9.

D. Chrome.
Battelle Development Corp., Brev. franç., No. 921, 342 (Feb., 1946).
P. A. Jacquet, C.R., *227*, 1948, p. 556.

E. Cobalt.
W. C. Elmore, Physical Rev., *53*, 1938, p. 757.

F. Copper and Its Alloys.
Le Matériel Téléphonique *(H. Figour & P. Jacquet)*, Brev. franç., No. 707, 526 (1930).
P. A. Jacquet, Nature, *135*, 1935, p. 1076; C.R., *201*, 1935, p. 1473; Trans. Electrochem. Soc., *69*, 1936, p. 629; Bull. Soc. Chim., France, 5 e Série, *3*, 1936, p. 705.
G. Kuhn, Metal Progress, *36*, 1939, p. 755.
R. B. Gordon & M. Cohen, Trans. Amer. Soc. for Metals, 1939.
C. Benedicks & Ljjungren, Korr. u. Metallschutz, *16*, 1940, p. 17.
W. Engelhardt, Metallwirtschaft, *20*, 1941, p. 349.
G. J. Foss & Shiller, Metal Progress, *42*, 1942, p. 77, 98.
J. L. Rodda, Min. and Metallurgy, *24*, 1943, p. 323; Metal Progress, *42*, 1942, p. 209.
P. A. Jacquet, Rev. Métallurgie, *42*, 1945, p. 133.
V. I. Lainer, Tsvet. Metallg. (U.S.S.R.), 1946 (3) p. 54.
J. Horowitz & J. Maltz, Metal Progress, *51*, 1947, p. 263.
P. Berger, Third Intern. Electredeposition Conference, London, 1947.
E. Der Mateosian, Iron Age, 16 Jan., 1947, p. 51.
P. Giroudot, Journées d'Automne de la Société franç. de Métallurgie, Paris, Oct., 1948.

G. Tin.
P. A. Jacquet, Intern. Tin Research Develop. Council, Publ. No. 90 (1939).
L. Capdecomme, R. Dargent & M. Orliac, Métaux-Corrosion-Usure, *17*, 1942, p. 53.
H. C. J. De Decker & A. P. Krijff, Polytech. Weekbl., *37*, 1943, p. 249, 269.

H. Iron, Carbon Steels, Stainless Steels, Special Steels.
P. A. Jacquet & P. Rocquet, C.R., *208*, 1939, p. 1012; The Metallurgist (Suppl. to the Engineer), 30 June, 1939; Metal Progress, *36*, 1939, p. 771.
W. C. Elmore, J. Applied Physics, *10*, 1939, p. 727.
G. Kiefer, Iron Age, *144*, 21 Dec., 1939, p. 30, 66.
G. E. Pelissier, Jr., H. Markus & R. F. Mehl, Metal Progress, *37*, 1940, p. 55.
H. H. Uhlig, Trans. Electrochem. Soc., *78*, 1940, p. 265.
N. A. D. Parlee & R. E. Dimock, Canad. chem. Process Ind., *24*, 1940, p. 367.
A. L. Field & I .C. Clingan, Steel, *106*, 22 April, 1940, p. 54.
T. W. Lipert, Iron Age, *145*, 11 Jan., 1940, p. 22.
S. Tour, Steel, *106*, 17 June, 1940, p. 72.
E. Hugony, Metallurgia Italiana, *33*, 1941, p. 343.
V. R. Farlow & L. H. McCreery, Metals and Alloys, *14*, 1941, p. 692.
G. F. Meyer, G. D. Rahrer & J. R. Vilella, Metals and Alloys, *13*, 1941, p. 424.
A. L. De Sy & H. Haemers, Stahl u. Eisen, 20 Feb., 1941, p. 185; Rev. Métallurgie, *38*, 1941, p. 122.
P. Schafmeister & K. E. Volk, Arch. Eisenhutt., Nov., 1941, p. 243; Technische Mitt. Krupp, Oct., 1941.
H. H. Uhlig, 29 th. Ann. Conv. Amer. Electroplaters Soc., June, 1941, p. 20.
C. L. Faust & H. A. Pray, 29 th. Ann. Conv. Amer. Electroplaters Soc., June, 1941, p. 104.
C. B. F. Young & W. L. Brytczuk, Metal Finishing, *40*, 1942, p. 237, 306, 317.
R. W. Parcel, Metal Progress, *42*, 1942, p. 209.
American Soc. for Testing Materials, 1942 Book, p. 1491.
E. Lowgren & G. Hildebrand, Jernkontorets Ann., *126*, 1942, p. 131.
L. von Hamos, Jernkontorets Ann., *126*, 1942, p. 568.
R. L. Imboden & R. S. Sibley, Trans. Electrochem. Soc., *82*, 1942, p. 227.

E. Knuth-Winterfeldt, Kemisk Maanedsblad, No. 11, 1943; Jernkontorets Ann., *128*, 1944, p. 77.
S. Wernick, Sheet Metal Industries, *19*, 1944, p. 979.
S. R. Prance, Steel, *116*, 1945, p. 106.
S. Wernick, Sheet Metal Industries, *22*, 1945, p. 1951.
O. Zmeskal, Metal Progress, *48*, 1945, p. 290.
J. Heyes & W. A. Fischer (K.W.I. für Eisenforschung, non-published work). See *G. E. Gardam*, German Electroplating Industry, B.I.O.S., No. 429, Oct. 1945.
H. S. Schaustas, W. H. Braun & I. C. Clingan, Steel Processing, *32*, 1946, p. 372.
W. A. S. Sparks, J. Electrodepositors Tech. Soc., *21*, 1946, p. 245.
C. B. F. Young & K. R. Hesse, Metal Finishing, *45*, Febr. 1947, pp. 63, 84; *45*, Mar. 1947, p. 64.
J. L. Waisman, Metal Progress, *51*, 1947, p. 606.
H. Evans & E. H. Lloyd, J. Electrodepositors Techn. Soc. *22*, 1947, p. 73.
C. L. Faust, Monthly Rev., *34*, 1947, pp. 1365, 1399
H. J. Merchant, J. Iron Steel Inst., *155*, 1947, p. 179; *156*, 1948, p. 208.
E. Knuth-Winterfeldt, Métaux et Corrosion, *23*, 1948, p. 5.
G. Y. Pochtar & A. M. Gurev, Stanki i Instrument (U.S.S.R.), *18*, No. 3, 1947, p. 27.
E. Der Mateosian, Iron Age, *16*, Jan. 1947, p. 51.
A. L. De Sy & H. Haemers, Metal Progress, *53*, 1948, p. 368.
P. A. Jacquet, C. R., *227*, 1948, p. 556; Journées d'Automne de la Société franç. de Métallurgie, Paris, Oct. 1948.

I. Magnesium.
W. K. J. Pearson (Magnesium Metal Corp.), Brit. Pat. No. 550,175, No. 550,176 (Dec. 1942).
P. A. Jacquet, Publ. No. VI, C.G.C.T.-L.M.T., Mar. 1943, Métaux-Corrosion-Usure, *19*, 1944, p 71.
G. Black, Metal Finishing, *45*, June 1947, pp. 26, 94; *45*, July 1947, p. 84.

J. Molybdenum.
Le Matériel Téléphonique (*H. Figour & P. A. Jacquet*), Brev. français No. 707,526 (1930).

K. Nickel and Its Alloys.
Le Matériel Téléphonique (*H. Figour & P. A. Jacquet*), Brev. français No. 707,526 (1930).
P. A. Jacquet, Métaux et Corrosion, *14*, 1939, p. 127.
A. W. Hothersall & R. A. F. Hammond, J. Electrodepositors Techn. Soc., *16*, 1940, p. 83; Metal Industry, *58*, 1941, p. 193; Steel, *103*, 19 May 1941, p. 73.
Sakae Tajima, J. Central Aeronaut. Res. Inst. (Japan), No. 3, 1944, p. 155.
S. Wernick, Sheet Metal Industries, *20*, 1944, p. 1541.
H. Evans & E. H. Lloyd, J. Electrodepositors Techn. Soc., *22*, 1947, p. 73.

L. Lead and Its Alloys.
P. A. Jacquet, Bull. Soc. Chim. France, 5e Série, *3*, 1936, p. 705; Rev. Métallurgie, *37*, 1940, p. 210.
L. Koch & H. Staunau, Metallwirtschaft, *20*, 1941, p. 752.
H. C. J. De Decker & A. P. Krijff, Polytech. Weekbl., *37*, 1943, pp. 249, 269.
H. C. J. De Decker, A. P. Krijff & J. M. Pluut, Third Intern. Conference on Electrodeposition. London. 1947.
Anonymous, Metal Finishing, *46*, Jan. 1948, p. 86.
C. Chalin & I. Epelboim, Rev. Générale de l'Electricité, *57*, 1948, p. 254.

M. Tantalum.
J. F. Gall & H. C. Miller (Pennsylvania Salt Mfg. Co.), Canad. Pat. No. 435,261 (June 1946).
Pei Hisu Wei (International Standard Electric Corp.), Brev. franç. No. 920,215 (April 1947).

N. Tungsten.
J. M. Hughes & E. A. Coomes, Physical Rev., *55*, 1939, p. 1138.
J. M. Hughes, P. A. Guarino & E. A. Coomes, Bull. Amer. Physical Soc., *15*, 10 April 1945, p. 34.
A. A. Brown, Physical Rev., *60*, 1941, p. 170.
H. W. Wood, Metal Progress, *51*, 1947, p. 261.
W. G. Pfann, Bell Laboratories Record, *26*, May 1948, p. 205.

O. Zinc.
W. H. J. Vernon & E. G. Stroud, Nature, *142*, 1938, p. 477, 1161.
M. Orliac, Diplome d'Etudes Supérieures, Université de Toulouse, 1941.
L. Capdecomme & M. Orliac, C. R., *213*, 1941, p. 383.
E. Raub & B. Wullhorst, Mitt. Aus dem Forschungsinstitüt für Edelmetalle, *6*, Nov. 1941, p. 1.
L. Capdecomme, R. Dargent & M. Orliac, Métaux-Corrosion-Usure, *17*, 1942, p. 53.
J. L. Rodda, Metal Progress, *42*, 1942, p. 209; Mining and Metallurgy, *24*, 1943, p. 323.
H. C. J. De Decker & A. P. Krijff, Polytechn. Weekbl., *37*, 1943, p. 249, 269.
P. A. Jacquet, Publ. N. VI, C.G.C.T.-L.M.T., 1943; Métaux-Corrosion-Usure, *19*, 1944, p. 71.
D. McLean, Nature, *158*, 1946, p. 307.
H. C. J. De Decker, A. P. Krijff & J. M. Pluut, Third Intern. Conference on Electrodeposition, London, 1947.

14. *G. Kuhn*, Metal Progress, *36*, 1939, p. 755.
15. *A. L. De Sy & H. Haemers*, Stahl u. Eisen, *61*, 1941, p. 185; Rev. Métallurg., *38*, 1941, p. 122; Aluminum No. 3, 1942, p. 96; Metal Progress, *53*, 1948, p. 368.
E. Knuth, A. L. De Sy & H. Haemers, Stahl u. Eisen, *61*, 1941, p. 777.
16. *E. Lowgren & G. Hildebrand*, Jernkontorets Ann., *126*, 1942, p. 131.
Anonymous, Aluminum, *24*, 1942, p. 438.
E. Knuth-Winterfeldt, Kemish Maanedsblad, No. 11, 1943; Jernkontorets Ann., *128*, 1944, p. 77; Métaux et Corrosion. *23*, 1948, p. 5.
J. L. Waisman, Metal Progress, 51, 1947, p. 606.
17. *L. A. Hauser*, Iron Age, *153*, 20 Jan. 1944, p. 48.
Lamare, Métaux et Corrosion-Usure, 20, 1945, p. 83.
H. J. Merchant, J. Iron Steel Inst., *155*, part 2, 1947, p. 179.
18. Anonymous, Electropolisher, Rev. of Scientific Instruments, *17*, 1946, p. 284.
Anonymous, Electropolisher, Chemical and Eng. News, *24*, 1946, p. 2399. See also *R. W. Parcel*, Metal Progress, *42*, 1942, p. 209; Metal Ind., *62*, 1943, p. 69.
19. Métaux et Corrosion, *23*, 1948, p. 5.
20. *E. Der Mateosian*, Iron Age, *16*, Jan. 1947, p. 51.
U. R. Evans & D. Whitwham, J. Electrodepositors Techn. Soc., *22*, 1947, p. 24.
21. *J. H. Goodyear*, Metal Progress, *46*, 1944, p. 106.
22. *F. A. Herr*, Metal Finishing, *45*, 1947, p. 72.
23. *E. Knuth, A. L. De Sy & H. Haemers*, Stahl u. Eisen, *61*, 1941, p. 777.
24. *W. Koster*, Z. f. Metallkunde, *36*, 1944, p. 124.
25. *L. Chamagne, H. Granjon & A. Leroy*, Métaux et Corrosion, *21*, 1946, p. 73.
26. *J. Mazia*, Monthly Rev. *34*, 1947, p. 237; Steel, *120*, 19 May 1947, p. 84.
27. *J. Heyes & W. A. Fischer*, non-published work. see *G. E. Gardam*, German Electroplating Industry, B.I.O.S., Report No. 429, Oct. 1945.
28. *J. Farran*, Métaux et Corrision, *23*, Jan. 1948, p. 9.
29. *L. von Hamos*, Jernkontorets Ann., *126*, 1942, p. 568.
A. Guy, Metal Progress, *46*, 1944, p. 104.
30. Rev. Métallurgie, *42*, 1945, p. 286.
31. See for example *R. A. Schaefer*, Iron Age, *59*, 10 April 1947, p. 60.
32. *R. S. Herwig*, Iron Age, *159*, 27 Mar. 1947, p. 48.
33. Métaux et Corrosion, *21*, 1946, p. 40.
34. C. R., *226*, 1948, p. 324; Métaux et Corrosion, *23*, Jan. 1948, p. 1; Journées d'Automne de la Societé franç. de Métallurgie, Paris, Oct. 1948; Brev. franç. demande No. 548, 617 (1948).
35. *C. Chalin et I. Epelboim*, Rev. Générale de l'Electricité, *57*, 1948, p. 254.
36. *P. A. Jacquet*, C. R., *227*, 1948, p. 591.

Welding, Brazing and Soldering of Plated Metals

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This article is an abstract of a paper presented before the Electrodepositor's Technical Society and The Institute of Welding in London in February, and is published here in view of the importance of the subject matter to American readers. Design limitations frequently require that plated metals be joined in this fashion, and the author points out some of the important considerations in such methods of joining.—ED.

SINCE steel is probably the most widely used metal, and is reasonably well joined by all the processes, the main concern will be with coated steels. Other coated metals will be discussed only when they are extensively used, or in instances of particular interest from the aspect of jointing.

Soldering

The low operating temperatures do not seriously affect any of the common coatings. The chief considerations are the type of flux which is necessary, the ease with which it keeps the surfaces clean and free from oxides, and the ability of the solder to "wet," and to alloy with, the coated metal.

Electro-Tin

Tin plating forms an excellent base for soldering, and is in fact an improvement over the uncoated metal, as even resin fluxes prevent oxidation, and the tin base solders naturally alloy readily with the tin plate. Electro-tinning is an accepted method of preparation for the soldering of steel and other metals, including copper and brass in electrical work where a non-corrosive flux must be used because it is often impracticable to wash off any residue.

Some relative difficulty can be experienced occasionally, which *Homer* and *Watkins*[1] showed to be due to excessively thin plating. The effect was found to be more pronounced if the plated material was stored for long periods before soldering. The minimum thickness of tin plating recommended for brass, copper and steel are given in Table I.

Table I.—Minimum Tin-Plating Thickness for Soldering.

Base Metal	Electro-tin plating. Thickness in inches	
	Stored—6 weeks	Stored—2 years
Brass	0.0002	0.0005
Copper	0.00015	0.0003
Steel	0.0001	0.0002

Hot-dip Tinning

This method provides a coating in which the tin immediately alloys with the metal surface, so that it provides the ideal base for soldering. The solder need only be flowed into the joint, and in some instances the parts can be sweated together without solder addition, providing the coating is at least 0.0005" thick.

In the "can making" industry, tinplate is soldered at extremely high speeds on fully automatic machines, the folded side seams, for instance, are soldered at the rate of several hundred cans a minute. Tin-lead solders are normally used, but during the war straight lead-silver alloys were introduced successfully on certain of these applications.[2]

It is of interest that the fairly recent method of manufacturing tinplate, by electrodeposition and subsequent heating and re-flowing of the coating, produces coatings which, although extremely thin, of the order of 0.00003", are still readily soldered even after storage.

Zinc Plated and Hot Galvanized Steel

The non-corrosive fluxes do not give good results, and an active flux is usually necessary. Oleic acid is useful, as its residue is considerably less corrosive than that of zinc chloride fluxes.

Solders containing antimony should not be used for zinc coatings.[2]

Tin-Zinc Plated Steel

This new plating, developed as a protective coating

for steel, is said to be readily soldered with non-corrosive fluxes.[3] Presumably here again non-antimonial solders should be used.

Cadmium Plating[3,4]

On copper and bass, this plating is fairly readily soldered with activated resin flux, although considerably inferior to tin plating. On steel, great difficulty is often experienced, but coatings heavier than 0.0003" give some improvement. Oleic acid or zinc chloride fluxes are a great improvement.

Here again, antimony-bearing solders are not advised.[5]

Nickel Plated Steel

The non-corrosive fluxes are not really satisfactory. Fluxes based on phosphoric acid give greatly improved soldering. The residue is also much less corrosive than that of zinc chloride or hydrochloric acid, and may even in certain circumstances form a protective coating.

Chromium Plating

The soldering of chromium plated metals requires an active acid flux, such as hydrochloric acid and zinc chloride, which dissolves the chromium and exposes the underlying metal.[4]

Copper or Silver Plating

These coatings can be readily soldered with non-corrosive fluxes. In the case of silver, a minimum thickness of 0.0003" appears to be an advantage.[3] These two platings can be applied to aluminum, for the specific purpose of making it easily soldered by conventional techniques and solders. It is usual to tin, after the copper or silver plating, either by plating or dipping.

An interesting fact emerges from the available information. Those platings which, as pure metals, are relatively easy to solder, such as tin, copper, silver or even cadmium, appear to suffer if the plating is too thin. Fairly heavy platings are desirable for soldering.

Brazing

A properly designed brazed joint should, in general, be completely filled by the brazing metal, with a continuous fillet at either end. This being the case, most brazed assemblies can readily be plated after brazing. This is to be recommended, except in special circumstances where the components are to have different finishes, where one must remain unplated, or where other factors make it necessary to plate first.

The temperatures involved in brazing, from say 630°C. to over 1100°C., are of first importance in considering the application to coated metals. The heat should not affect the coated metal in any of the following ways:

(1) The melting point of the coating should not be exceeded.

(2) Where the coating and the parent metal can form alloys of lower melting point than their own, the brazing temperature should be well below that of their eutectic.

(3) The adhesion of the plating must be such that the heat will not cause it to blister or peel.

(4) Where the plating is primarily decorative, its appearance should not be altered, directly or indirectly, by the heat.

The various tin, lead, cadmium and zinc coatings cannot normally be considered for brazing, because of their low melting points. Some very promising work is in progress on the resistance brazing in a welder, of copper to zinc plated steel, on a somewhat similar principle to that described later for silver plating. The work is not, however, sufficiently advanced to give details.

Nickel Plating

Nickel plated components can be readily brazed with most of the brazing media. The silver solders flow very readily over nickel surfaces, and are ideal for making close-fitting joints in plated steel or brass. These silver brazing alloys normally require a flux, even when used in reducing atmosphere furnaces.

However, if special precautions are taken to maintain a pure, dry hydrogen atmosphere, a flux may not be required.

Copper brazing is not normally recommended for nickel plated steel,[6] owing to the rapid loss of copper by diffusion into the nickel, and also to the re-solidification of the molten copper as the nickel alloys with it and raises its melting point. These factors seriously restrict the flow of copper in a joint. However, this is still the most common method of joining tungsten contacts either to plain or nickel plated steel, where no flow is required.

Chromium Plating

This plating can be considered unsuitable for brazing, as it usually has to be removed locally before brazing can take place, and the decorative finish is liable to be seriously impaired.

Copper Plating

Most of the brazing media can be applied readily to copper plated metals. In copper brazing, components are frequently plated with copper specifically to assist the process in one or more ways. Where joints are complicated or irregular in shape, such as between pressed sheet components, it is a ready method of introducing the brazing copper to the joint. When copper brazing steels containing appreciable amounts of chromium or other constituents, whose oxides are not readily reduced by the furnace atmosphere, the plating materially assists the process by preventing oxidation. Decarburization of steel during copper brazing can also be prevented by plating approximately .0003" thick.

Silver Plating

This plating, which is usually applied to copper

alloys, is readily brazed. The operating temperature must, however, be well below 780°C., which is the melting point of the silver-copper eutectic.

An interesting variation is the silver plating of copper or copper alloys, specifically for the purpose of brazing them together by heating them to just above the melting point of the eutectic. The method has been applied to the furnace brazing of pressed components of thin copper or brass sheet.[7] A special resistance seam welder is also used for brazing, on the same principle, silver plated beryllium copper diaphrams to plated brass pressings.[8]

Similar applications for brazing copper to either copper or brass in resistance welding machines have proved very successful.

Fusion Welding

As indicated earlier, fusion welding, involving as it does the application of an intense heat from a flame or an electric arc, which would either melt or seriously damage the coating, is not considered to be a suitable method for joining the coated metals under review.

Spot Welding

With heavy welding currents of the order of 4,000 to 40,000 amperes, depending on the metal and thickness, operating at low voltages of, say, 1 volt to 5 volts, it is essential that the resistance of the work must be extremely low.

Any coated sheets which have a resistance measureable in ohms or major fractions of an ohm are unsuitable for spot welding by present accepted techniques. Into this category fall a number of protective finishes, not electrodeposited, such as phosphate processes, black oxide coatings, etc.[9]

As the resistance of all coatings increases with thickness, and the welding heat is proportional to the resistance, it is imperative that the coating thickness should be consistent. Practical experience amply supports the fact that the best results are obtained with consistent, thin coatings.

Before considering any particular coated material, it is advisable to differentiate between:

(1) The ability to produce a consistent weld of satisfactory strength and properties.

(2) The problem of maintaining this equality of weld on a production basis. This is largely dependent on the effect of the coating on the welding electrodes, and the frequency with which they have to be cleaned or replaced. The need for frequent changing not only increases costs, but tends to increase the risk of faulty welding when electrode replacement is overlooked.

As a basis of comparison, good quality electrodes on clean mild steel should last from at least 1,000 up to possibly 9,000 welds, depending on the set-up, before re-machining.[10]

Electro-Tinned and Hot-Tinned Steel

Poviding the coating thickness is constant and less than 0.0003", the weldability is good.[9,11] However, tin "pick-up" on the electrodes, and consequent deterioration in welding, is very rapid. Depending on local conditions and coating finish required, electrode cleaning is usually necessary every 50 to 100 welds. The use of a sufficiently long post-weld "forge" period, during which electrode pressure is maintained until the work cools and the plating re-solidifies, effects some improvement. Some users favor domed, in preference to flat-tipped electrodes, mainly because they are easier to clean *in situ* without seriously affecting their profile.

Where complete removal of the tin from the outer weld surfaces during welding is permissible, excellent results may be obtained by tipping the electrodes with molybdenum, although this may introduce other problems.

Zinc-Coated Steel

Electro-galvanized steel is probably the most suitable coated steel for spot welding. The weldability is excellent, and electrode life is comparable with that for uncoated steel.[9] Present practice appears to favor standard "truncated cone" electrodes. One recent test showed an electrode life between trimmings of 1,800, compared with about 1,000 with 2" radius domed electrodes, although this may not be representative of all conditions.

Machine settings are about the same as for unplated steel with slightly increased pressure and current; excessive pressure and current should be avoided. Plating up to at least 0.0003" thick is quite satisfactory, providing it is consistent. Thicker coatings appear to become progressively unreliable. The plating tends to be removed somewhat at the outer surface electrode impressions.

Hot galvanized steel can be welded providing the coating thickness is consistent.[9,12] Fouling of the electrodes is extremely severe, with consequent deterioration of weld strength and involves electrode changing every 50 welds; for this reason the coating cannot be considered as suitable for large-scale production welding.

Tin-Zinc Plated Steel

Very recent tests by the British Welding Research Association and the Tin Research Institute on the spot welding of this new coating are understood to show that the weldability is good, and that electrode life is reasonably comparable with that on zinc-plated steel.

Cadmium Plated Steel

There is some diversity of opinion as to the suitability of this plating for spot welding. The general experience is, however, that the weldability is quite good,[13] though not so satisfactory as zinc plated steel.[11] The electrode sticking and life are also worse, electrode changing of the order of every 400 welds being usual. Plating disturbance is here again difficult to avoid.

Nickel Plated Steel

This material can be spot welded satisfactorily,[11,13]

although some users do report that the welds are sometimes very brittle. Very little information is available, but it is suggested that the trouble is less noticeable with platings up to 0.0003" thick.

Plating disturbance or removal at the electrode impressions is very slight, so that the protection should be reasonably unimpaired.

CHROMIUM PLATED STEEL

This material can be welded at machine settings corresponding to those for unplated steel. The weld strength may be largely dependent on the quality and adhesion of the plating.[11] The usual objection to spot welding this material is due to the indentation or marking of the placed surface, which it is virtually impossible to avoid completely.

Projection Welding

Even on uncoated steels it is much easier to produce consistent, metallurgically sound spot welds than the equivalent projection welds, particularly when the latter are made 3 or 4 at a time as is usually the case. For this reason the quality and consistency of plating is even more important than in spot welding. Also from the aspect of weldability, only those platings which are excellent for spot welding are likely to be really suitable for projection welding.

In contrast to this, in projection welding a much larger area of electrode is in contact with the work. As a result, the outer surfaces of the work tend to remain much cooler, and marking and disturbance of the coating is considerably reduced. This applies particularly to the component which does not have the original projection raised on it. Electrode life is correspondingly increased.

Seam Welding

Seam welding is used mainly in the fabrication of liquid containers of various types, and the question of pressure or liquid tightness is of more importance than the strength of the weld, which is invariably greater than that of the parent metal.

Most coated steels suitable for spot welding can be satisfactorily seam welded. The work, however, becomes much hotter than when spot welded, and it is virtually impossible to avoid damaging the coating. Terne plate and hot galvanized steel are liable to cause pick-up and fouling of the electrodes as in spot welding, though the effect is less noticeable on the large wheel electrodes. These materials are, however, satisfactorily welded on a large scale in the manufacture of petrol tanks and drums and similar articles.

A typical example is the welding of 18 s.w.g. terne plate gasoline tanks on a seam welder. Two features of the machine are of particular importance in welding coated steels, particularly heavy coatings such as this. Both electrode wheels are driven to ensure constant feed of the work without any slipping. The pressure on the electrodes is applied by a dead weight on an adjustable lever; this is claimed to be an improvement over the conventional pneumatic pressure because it maintains a more constant pressure on the work.

The coating is completely melted at the weld seam, but a reasonable protective coat is restored by the simple procedure of brushing the work during the welding operation, immediately as it leaves the electrodes, and re-spreading the coating while it is still molten.

Stitch Welding

The process is, in theory, applicable to all coatings which can be spot welded. It should be remembered that, because of the very high operating speed, the work and the electrodes become much hotter than in spot welding, and the damage to the coating and electrode pick-up are much more serious.

Butt or Flash Welding

The actual welding operation can be applied to almost any of the coated steels. However, the coating would invariably be damaged over a considerable area, and plating after welding and trimming is always to be recommended.

Conclusions

To summarize, the most suitable coating for soldering steel or non-ferrous metals is tin. Copper and silver plate are readily soldered with non-corrosive fluxes. Of the protective coatings for steel, the relatively new tin-zinc plating appears to be the most readily soldered.

In brazed assemblies, it is preferable to plate after brazing wherever possible. Several platings can, however, be satisfactorily brazed. In certain instances, either silver, copper or zinc plate is used either to assist the process or as an integral part of it.

For resistance welding, and in particular spot welding, a number of coatings are satisfactory. Probably the most suitable protective coating on steel is electrozinc plate.

Where steel components are to be welded, and subsequently soldered, tin-zinc plate appears to be a promising protective coating.

Whichever process is under consideration, it is essential that the plating should be of the highest quality, and of consistent specified thickness. When soldering, too thin plating is often troublesome; while when welding, the best results are invariably obtained with consistently thin plating.

References

1. *C. E. Homer* and *H. C. Watkins*, "Metal Industry," Jan. 3, 1941.
2. *R. G. Harper*, "Metal Industry," April 21 and 28, 1944.
3. *W. R. Lewis*, "Notes on Soldering," T.R.I. publicatoin.
4. *J. L. Miller*, "Modern Assembly Processes."
5. *W. E. Hoare*, "Sheet Metal Industries," Dec., 1943.
6. *A. G. Robiette*, "Metal Industry," Jan. 21, 1936.
7. British Patent Spec. Nos. 577,979 and 578,364.
8. *W. S. Simmie*, "Sheet Metal Industries," July, 1948.
9. *W. S. Simmie* and *A. J. Hipperson*, "Sheet Metal Industries," Mar., 1944.
10. *A. J. Hipperson* and *T. Watson*, "Welding," Nov., 1948.
11. American R.W.M.A. Handbook, 1942 Edition, 67, 68, 274.
12. *E. F. Pellowe* and *F. F. Pollak*, "Sheet Metal Industry," Aug., 1945.
13. R.A.E. Report M5927, June, 1940.

Rectifier Circuits and Power Costs

By L. W. Reinken, *Chief Engineer, W. Green Electric Co., Inc.*

THE performance of a Packard airplane motor cannot be properly determined if it is mounted on a Model T chassis! Similarly the performance of a metal rectifier cannot be correctly determined unless it is used in a circuit which fits the *characteristics of the rectifier*, as well as the required output, input AC, and other factors. Ignoring the rectifier characteristics may lead to grossly misleading conclusions—particularly with regard to power costs and overall efficiency.*

The purpose of this article is to clarify (without getting involved in a lot of mathematics), the relationship between choice of circuits and types of metal rectifiers.

The two circuits most commonly used for lower voltage power supplies, rated at 6 to 9 volts, are the three-phase wye shown in Fig. 1, and the three-phase bridge shown in Fig. 2.

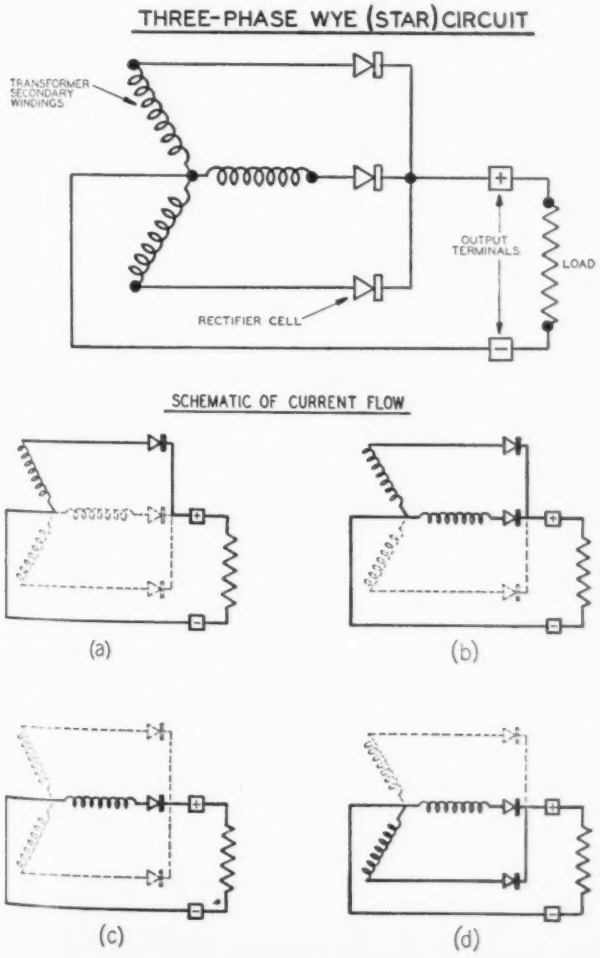

Figure 1.

The Wye Circuit

The smaller sketches in Fig. 1 show pictorially how the current flows in the wye circuit at a few different stages of the AC cycle.

In (1a) the current flows to the load through one rectifier arm only, and returns through the negative terminal to the transformer. In (1b) the current is divided so that part flows through one arm, and part through another, to the load, and back to the transformer. (1c) is similar to (1a), and (1d) is similar to (1b), except that different arms are involved. More sketches could be drawn, but the important thing to observe is that in the total current loop, the flow is either through *one* rectifier arm only, or through two arms dividing the current as though they were in *parallel*. The current never flows through two or more arms in *series*.

The Bridge Circuit

In Fig. 2 the smaller sketches show, pictorially, how the current flows in the bridge circuit at a few different stages of the AC cycle.

In (2a) the current flows through one rectifier arm to the load; at the negative terminal it divides and flows through two additional rectifier arms to get back to the transformer. In (2b) the current flows through two rectifier arms, joins up at the positive terminal, goes through the load to the negative terminal, and then through *another* rectifier arm back to the transformer. (2c) is similar to (2a), and (2d) is similar to (2b), except that different rectifier arms are involved.

The point to remember here is that the current always flows through a *series* network consisting of one rectifier arm plus two more arms which may be considered as being in *parallel*.

Voltage Drops

The "arm" of a low voltage rectifier power supply is usually made up of a number of metal rectifier cells in *parallel*, and there is a certain voltage drop when current flows through the arm. This voltage drop is one of the factors which must be considered when designing a rectifier.

From a study of the two circuits shown, one would expect that there would be a greater voltage drop in the bridge circuit than in the wye circuit. This is so in practice and is confirmed by the standard circuit formulas: the formula for the bridge circuit includes the term "2dv," where "dv" is the voltage drop for one arm, whereas the formula for the wye circuit shows only "dv" for the voltage drop. From the standpoint of *voltage drop alone* the wye circuit is

superior to the bridge, but there are other factors that must be considered.

Inverse Voltage

Another basic difference between the two circuits is this: for the same DC output voltage, the inverse voltage applied to the rectifier arms in the wye circuit is higher than that which appears across the rectifier arms in the bridge circuits. Approximately, the inverse voltage in the wye circuit is twice as high as in the bridge circuit.

Now we can assemble a few basic facts about the two circuits under discussion:

BRIDGE CIRCUIT—Has twice as many rectifier arms, has greater voltage drop, but lower inverse voltage across the rectifier arms.

WYE CIRCUIT—Has fewer rectifier arms, has lower voltage drop, but higher inverse voltage across the rectifier arms.

Suppose we are designing a 6 volt power supply and plan to use selenium rectifier cells which can, without difficulty, block high inverse voltages. The wye circuit is the logical one to use, because the bridge circuit would require twice as many cells and would have a higher voltage drop resulting in lower overall efficiency.

On the other hand, suppose we want to use copper oxide rectifier cells, which have a much lower inverse voltage rating. If we tried to use the wye circuit it would be necessary to provide, in each of the three arms, at least two cells in *series* in order to withstand the inverse voltage. (See Fig. 3.) The voltage drop would be at least doubled (since the current must now flow through *two* or more cells in series) and the circuit would use at least as many cells as would be required for the bridge circuit. The bridge circuit should be used with copper oxide cells.

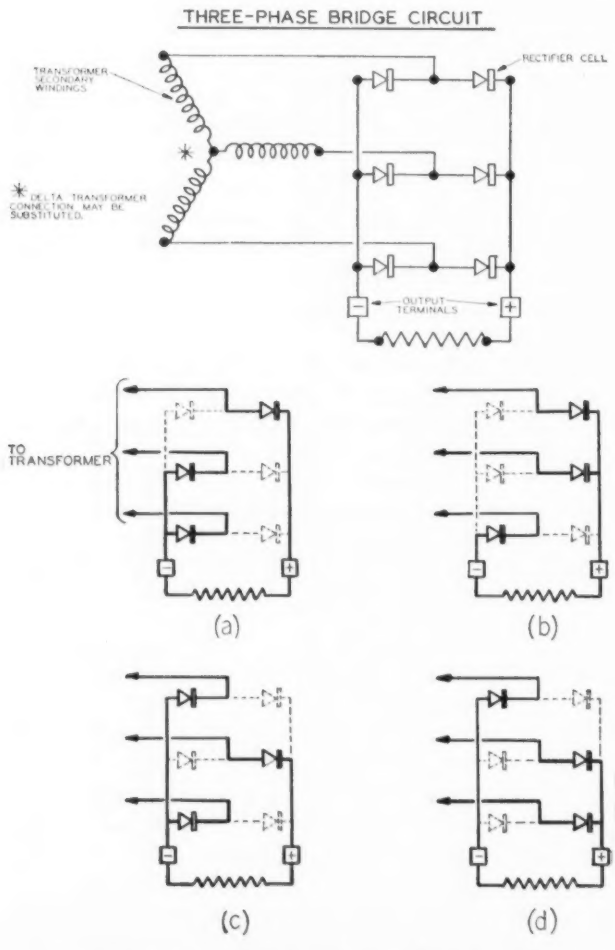

Figure 2. Current flow in a 3-phase bridge circuit.

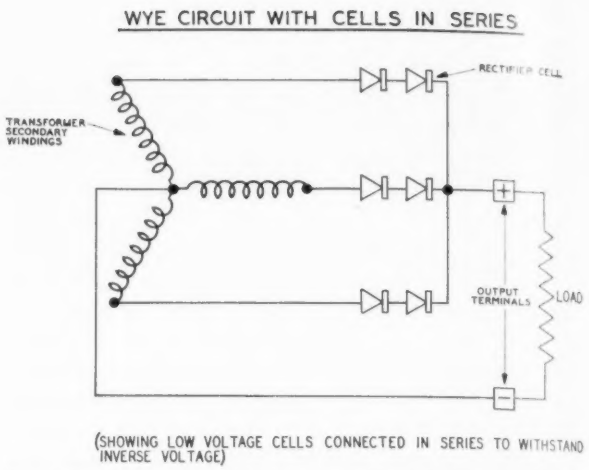

Figure 3. Wye circuit required for use with copper oxide rectifiers.

Practical Results

Performance tests of actual models confirm the qualitative reasoning outlined above.

For six volts output, the better circuit to use with copper oxide or other low voltage metal rectifiers, is the bridge circuit. If the wye circuit is used, with an increased number of cells per arm, the overall efficiency is less.

Conversely, when using the higher voltage selenium cells, the better circuit (for DC output up to at least 9 volts) is the wye circuit and not the bridge. The bridge circuit, for 6 volt output, has an overall efficiency of only about 60%. Using the wye circuit, however, the overall efficiency will be 65% to 70% or more. For 8 and 9 volt units the efficiency is easily over 70%.

Conclusion

It is hoped that these notes will help to explain why different circuits are used (and correctly used) in different types of metal rectifier equipment. The facts, which have been presented in rather simplified form, are well known to rectifier engineers. It is unlikely that any competent power supply manufacturer will offer you a "Packard engine" rectifier in a "Model T" circuit.

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* *The following definition of "rectification efficiency," awaiting formal adoption by the Metallic Rectifier Section of N.E.M.A., applies to "rectification efficiency" or "overall efficiency" as used in this article: "the ratio expressed in percent of the product of average DC volts and DC amperes to the input AC watts.". In plain words, if the rectifier output is six volts one thousand amperes (i.e., 6 kilowatts), and the AC input is 8.5 kilowatts then the "rectification efficiency" would be 6 / 8.5 = 70% plus.*

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Blue Black Finish on Brass

Question: Can you send us the formula for producing a blue-black color on yellow brass parts?

M. M.

Answer: The following formula can be used:

Copper Carbonate	16 oz.
Ammonium Hydroxide	¼ gal.
Water	3¾ gal.

(An excess of carbonate is essential). The bath is heated to about 180°F. for use. Other formulas may be found in the Guidebook-Directory. You might also be interested in using a prepared bath for producing various colors on brass, and the names of firms who can supply such baths are being forwarded.

Electrolytic Plating Thickness Tester

Question: We recently heard of a new method for testing the thickness of plating deposits that uses an electrolytic principle. Can you give us any further information on this?

O. H. D.

Answer: You are probably referring to the electrolytic thickness tester described by Dr. Howard T. Francis in the March issue of the Journal of The Electrochemical Society. This tester was developed at the Armour Research Foundation, and was the subject of a recent patent (U. S. Patent 2457234). Briefly, it measures the time required to strip the coating under standard conditions of amperage and stripping reagent, and is stated to be accurate to within 2% for even very thin deposits. To the best of our knowledge this equipment is not commercially available as yet.

Buffing Compounds and Brass Tarnishing

Question: Would it be better to remove the buffing compound from brass parts immediately after buffing, or leave it on, if the parts are going to stand around awhile before plating? We are particularly interested in the possibilities of preventing tarnishing during this storage period.

W. J. P.

Answer: The answer as to which is best would depend entirely on what type of compound you are buffing with. If the binder in your buffing compound contains any material that could turn rancid and form free acid, corrosion and tarnishing of the brass would follow, but if the grease binder is stable and neutral in nature it would provide a barrier to any fumes that might cause tarnishing during the storage period. Only a test with your particular buffing compound will enable you to decide on the best procedure.

Brightener for Silver Plating

Question: We wish to obtain a product called Grünau 1005, which we have heard is being manufactured on license in the U. S. A. by an American firm. This product is used as a brightener in cyanide silver plating solutions, and was developed in Germany by a man named Weiner. Can you tell us who is making such a product?

A. E.

Answer: We have made numerous inquiries, but have been unable to locate any information on this material. If any readers of Metal Finishing can supply any information on this brightener both the inquirer and your distressed editor will be most appreciative.

Bright Finish on Silver Brazed Brass

Question: We are treating our silver-brazed brass parts in the usual Nitric-Sulfuric bright dip for brass, but the brazed area takes on a black smudge. How can we produce a bright, unetched finish on the brass without getting this discoloration at the brazed joints?

R. A. L.

Answer: The brazed parts should first be thoroughly soaked in hot water to remove the brazing flux. This can then be followed by the descaling dip, after which a reverse current treatment for a short period of time in a 4 oz./gal. Sodium Cyanide solution will remove the black smudge.

Several firms market bright dips for this type of work. Their names are being sent to you.

Reducing Trivalent Chrome

Question: I am having trouble in my chrome plating bath in controlling the trivalent chrome content, which keeps building up. How can I reduce this back to normal?

M. C. C.

Answer: The trivalent chrome can be reduced in your chrome plating solution by operating the bath overnight, using a small cathode area and a large lead anode area. A rapid build-up in trivalent chrome indicates an insufficient lead anode area for the amount of work you are processing. Add more anodes to the tank to overcome this difficulty.

Dark Brown Colors on Copper

Question: We are interested in a finish for copper plate that is a dark brown. We prefer a dip that can be lacquered after buffing certain sections to a bright mirror finish. Any information that you can furnish will be appreciated.

J. F. C.

Answer: There are a number of prepared materials available for producing such oxidized colors on copper and copper alloys. The names of suppliers of these materials is being forwarded. Various baths, consisting essentially of soluble sulfides, are usable. Two typical formulas are as follows:

1) Liquid sulfur ... 1 oz./gal.
   Liver of sulfur ... 2 "
   Ammonia ..... ¼ "

   Us at room temp. Immerse parts until the desired color is obtained.

2) Liver of sulfur ... 2 oz./gal.
   Caustic soda .... 3 "
   Use at 170°F.

In order to use these baths a heavy deposit of copper must be plated on the parts, as some of the copper is removed in the baths. Too thin a copper deposit will merely be stripped off the base metal.

Tarnish Resistant Finish for Silverware

Question: We have heard of a treatment of silverplated articles to increase their resistance to tarnishing, using some kind of a beryllium bath. Can you tell us where we can obtain further details on this process?

W. H. C.

Answer: Price and Thomas first described an electrolytic treatment of silverplated articles to resist tarnishing in the *Journal of the Institute of Metals*, 1939, Vol. 65, p. 247. The essentials of the process are as follows: the work is made cathodic in the following bath at about .035 ASF for 5 minutes:

Beryllium sulfate ..... .64 oz./gal.
Ammonium Hydroxide .. .3 fl. oz.

Anodes were of 7% tin-lead alloy. The film is invisible, a test for its presence being to apply a drop of 20% potassium ferrocyanide to the surface. If the film is present no change in the silver surface will have taken place, but in the absence of the film a purplish-brown stain will form where the ferrocyanide contacted the silver. These authors remarked that the film was not too durable and would be removed in the course of regular use of the plated articles such as tableware, etc. A commercial preparation has recently appeared on the market for treating silverware to resist tarnishing. The name of the firm marketing this material is being sent to you.

Hydrogen Embrittlement of Plated Springs

Question: We have been baking our zinc plated springs within a period of 1-3 days after plating them. Our customer claims that this is poor practice and that the springs are liable to fail in service, even though our tests indicate a complete lack of brittleness after our regular baking cycle. Can you tell us whether or not there is any basis for our customer's fears?

L. T. B.

Answer: It is advisable, of course, to relieve any hydrogen absorption as soon after plating as possible. Any delay just increases the length of time that the parts are in a critical condition and cannot be flexed or distorted.

However, if your present baking cycle eliminates all the effects of hydrogen absorption, there is no basis for believing that they will be subject to early failure simply because of the delay between plating and baking.

PATENTS

Continuous Galvanizing

U. S. Patent 2,459,161. *Arch W. Harris and Alfred H. Ward, assignors to American Steel & Wire Co.*

A ferrous metal coating method comprising wetting the ferrous metal with a water solution of ammonium chloride, drying the metal so it retains a coating of ammonium chloride, heating the metal to temperatures ranging from 660° F. to higher temperatures insufficient to melt the ferrous metal in an atmosphere containing sufficient hydrogen to make it reducing respecting the formation of iron compounds by the ammonium chloride, and subsequently coating the ferrous metal with molten metal selected from the group consisting of zinc, tin, aluminum and their alloys.

Lead-Tin Alloy Plating

U. S. Patent 2,460,252. *Arthur H. DuRose and John D. Little, assignors to The Harshaw Chemical Co.*

An aqueous, acid lead-tin plating solution essentially consisting of from 100 to 400 grams per liter combined concentration of lead and tin ions, negative ions of the class consisting of fluoborate and sulfamate and an addition agent effective to cause increased deposition of tin in proportion to lead deposited, the concentration of tin ions being from 1% to 5% of the combined weight of lead and tin ions, and said addition agent being present to the extent of from 0.2 to 5 grams per liter and being selected from the class consisting of resorcinol, catechol, hydroquinone, pyrogallol, phloroglucinol, phenol, naphthol, cresol, 3,4 dihydroxydiphenyl, orthobromophenol, p-amino phenol and o-amyl phenol.

Pretreatment for Plating on Zinc Alloys

U. S. Patent 2,461,228. *Donald L. Miles, assignor to American Chemical Paint Co.*

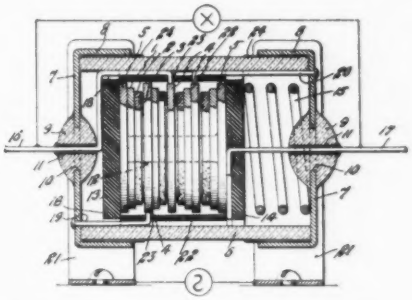
In the art of electroplating surfaces of zinc and zinc base alloys the step of treating the surface prior to the electroplating operation by subjecting it to the action of an aqueous bath containing the following ingredients in approximately the proportions indicated:

Mineral spirits	gals.	0.3360
Phosphoric acid (75%)	gals.	0.2418 to 0.4835
Cyclic coal tar bases	gals.	0.0144
Sulphuric acid (66° Bé.)	gals.	0.0049
Thiourea	lbs.	0.0250
Polymerized ethylene oxide condensate (100% basis)	lbs.	0.0135

Sealed Rectifier Stacks

U. S. Patent 2,459,788. *Walter F. Bonner, assignor to Federal Telephone and Radio Corp.*

In the cartridge type electric current rectifying element of the type that comprises a stack of rectifier elements, a plurality of electrical conductors conected to certain elements of said stack; the improvements that comprise a tubular casing, open at the ends, formed of electrical insulating material and adapted to receive and surround said stack with the conductors extending at least to the ends of said casing, said casing being provided with two external annular silver coatings integral therewith, one located near each end thereof metallic cup-like terminal caps, one on each end of said casing, overlying and hermetically united with the adjacent external annual silver coating on the casing in a manner precluding rotation of the cap relative to the casing, each of said caps being connected to one of said conductors; at least one of said caps having a centrally located opening formed therein, an insulative bead mounted in said opening and hermetically joined to the margin thereof, a metallic sleeve, open at the ends, mounted in said bead without contact with the cap in which the bead is positioned and extending in a direction substantially coaxial with the casing, whereby one of the conductors connected to the rectifier stack extends through and is hermetitcally sealed to said sleeve to provide an additional external terminal of the rectifier.



Phosphate Coatings

U. S. Patent 2,462,196. *George W. Jernstedt, assignor to Westinghouse Elec. Corp.*

In the process of treating ferrous, zinc and cadmium metal surfaces, to provide corrosion resisting coatings thereon, the steps comprising, applying to the metal surface an aqueous solution consisting essentially of from 0.1% to 2% of ortho-disodium phosphate and from 0.001% to 0.1% of zirconium present as a water soluble compound, the orthodisodium phosphate and the zirconium compound having been previously combined by dissolving them in water and evaporating to dryness, and the balance being water, to provide for activating the metal surface, and thereafter applying to the activated metal surface a solution comprising phosphoric acid phosphates and an oxidizing agent to produce a phosphate coating thereon.

Electroetching Copper Alloys

U. S. Patent 2,462,197. *George W. Jernstedt, assignor to Westinghouse Elec. Corp.*

The method of electroetching the surface of a copper base alloy member containing at least 60% copper comprising making the member the anode in an electrical circuit, applying to the surface of the member an aqueous electrolyte having as its essential ingredients from 20% to 85% by weight of phosphoric acid, from 25% to 0.1% by weight of nitric acid and the balance water, and passing an electrical current through the circuit including the member and the aqueous electrolyte to etch the surface of the member to produce a substantially uniform microscopic roughening and pitting of the surface to enable organic finishes to adhere more tenaciously.

Chrome Plating Propeller Blades

U. S. Patent 2,462,615. *George Dubpernell, assignor to United Chromium, Inc.*

In a method for reducing the loss of fatigue strength of steels for aeroplane propeller blades consequent upon the electrodeposition of chromium protective coatings thereon, passing plating current from an anode to said steel part, as cathode, immersed in a cold aqueous bath below 40°C. containing from 500 g./l. upward to saturation

of chromic (CrO_3) and sulphate catalyst acid radicals, the ratio between the chromic acid and the sulphate catalyst acid radical being between 230 to 1 and 160 to 1, electrodepositing from approximately .0005 to .001 inch chromium and heat treating the plated steel part to relieve stresses in the plated steel part.

Zinc-Silicate Metal Coating

U. S. Patent 2,462,763. *Victor C. J. Nightingall.*

The method of producing a hard protective coating on a ferrous metal surface which comprises applying to the surface a coating of a composition comprising finely divided metallic zinc incorporated in an aqueous solution of an alkali silicate, the aqueous solution containing about 20% to 40% by weight of the alkali silicate, the zinc being present in amount of about 100% to 350% by weight of said solution, and converting the coating to a substantially insoluble condition by reacting carbon dioxide therewith.

Bright Copper Bath

U. S. Patent 2,462,870. *Frank R. Keller, assignor to General Motors Corp.*

A bath for electrodeposition of copper in bright or semi-bright condition consisting essentially of an aqueous solution containing, per liter, approximately 210 grams copper sulphate, 30 grams sulphuric acid, 0.8 gram molasses and 0.04 gram thiourea.

Diffused Chrome-Brass-Copper Deposits

U. S. Patent 2,463,039. *George W. Kellogg, assignor to General Motors Corp.*

The method of forming a corrosion-resistant surface on a ferrous metal surface which includes, electrodepositing a layer of copper of about .0001″ to .0005″ in thickness onto the ferrous metal layer, applying to the electrodeposited layer of copper a coating .0002″ to .0005″ in thickness composed of about 70% copper and 30% zinc by simultaneously electrodepositing the copper and zinc in the given percentages onto the electrodeposited copper layer, applying a coating of chromium to the copper-zinc coating, and thereafter heating the ferrous metal, electrodeposited copper layer, electrodeposited copper-zinc coating and chromium coating at a temperature of about 800° F. to 950° F. for a time ranging from ten to about thirty minutes.

Accelerating Phosphate Coating

U. S. Patent 2,463,496. *William S. Russell, assignor to Parker Rust Proof Co.*

The method of producing a phosphate coating upon a surface composed principally of metal of the group consisting of iron, zinc, magnesium, copper, and aluminum, which comprises subjecting the surface to the action of a solution containing as its essential coating chemicals an acid phosphate of metal of the group consisting of zinc, manganese, iron, calcium and cadmium, and accelerating the coating action of the solution by a sulphonated indigoid compound dissolved in the solution in an amount sufficient to effect such acceleration.

Making Dust-Free Alkaline Detergent

U. S. Patent 2,463,680. *Thomas E. Corrigan, assignor to Wyandotte Chem. Co.*

The process of making a dust-free, homogeneous chemical product, comprising the steps of mixing together substantially equal parts by weight of dry solid sodium hydroxide of 10 to 20 mesh particle size and dry solid sodium carbonate the majority of which has a particle size not larger than 100 mesh, rolling such mixture under pressure into a sheet-like flake having a thickness of not over 0.1 inch, and then breaking such flake into smaller flake particles, the majority of the latter having a particle size of no smaller than 20 mesh.

Increasing Conductivity of Selenium

U. S. Patent 2,463,753. *Adrianus J. Dekker, assignor to Hartford Nat'l Bank & Trust Co.*

A process for increasing the conductivity of selenium which comprises the steps of adding a non-hygroscopic complex halide containing an admixture of a halide which is hygroscopic and decomposes in air and which increases the conductivity of the selenium to the selenium, and heating the complex halide in the presence of the selenium to decompose the complex halide to obtain the admixture component for increasing the conductivity of the selenium.

Front Surface Mirrors

U. S. Patent 2,464,256. *Donald M. Packer.*

A front-surface reflector comprising a di-electric base body portion having a finished surface, an intermediate layered deposit comprising a primary layer of thermal evaporated chromium deposited onto said finished surface, a layer of thermal evaporated nickel deposited on said chromium layer, and a front surface layer of electrodeposited rhodium deposited onto said nickel layer, said electrodeposited front-surface layer having a contour substantially identical to that of said finished surface.

Soldering Indium Plated Articles

U. S. Patent 2,464,821. *Maria T. Ludwick & William S. Murray, assignors to The Indium Corp. of America.*

The method of making a brazed or soldered joint which comprises applying a thin film of metallic indium to metal surfaces to be joined, applying to the indium-coated surfaces a molten indium-free lead-base alloy composed of 3% silver and the balance essentially lead and with which the metallic indium alloys in situ, and solidifying the resulting indium-silver-lead alloy while in contact with said metal surfaces.

Analytical Control of Tin Fluoride Plating Baths

U. S. Patent 2,464,846. *Joseph H. Buser, assignor to National Steel Corp.*

A method of testing tin-fluoride tin plating solutions comprising setting up standards by determining the amount of precipitate formed when a known quantity of oxidizing agent is added to each of a plurality of test solutions of the same known quantity having predetermined different molar ratios of fluoride to tin, taking a sample of the same quantity of the plating solution to be tested, and adding the same quantity of oxidizing agent under the same conditions to the sample whereby the amount of precipitate formed in the sample may be compared with the amount of precipitate formed with the standards so as to determine the molar ratio of fluoride to tin in the solution.

Engineering Information Useful In Designating Metallic Surface Treatments

Engineering Data Sheet

Plating Rack Construction

The information in the following tables will be found valuable in designing and constructing plating racks for heavy production work. Table 2, which designates the proper type of metal for various baths, assumes that adequate insulation will be used on the completed rack.

TABLE 1—MAXIMUM PRACTICAL AMPERAGES

Rectangular Conductors

Size	*Copper*	*Alum.*	*Brass*	*Iron*	*Phos. Bronze*
⅛x¼	31	19	6	4	8
⅛x⅜	47	28	9	5	12
⅛x½—¼x¼	62	38	12	8	15
⅛x⅝	78	48	16	10	19
⅛x¾—¼x⅜	93	57	19	11	23
⅛x1—¼x½	125	76	25	15	31
⅜x⅜	140	85	28	17	35
¼x⅝	156	95	31	19	39
¼x¾—⅜x½	187	114	37	22	47
⅜x⅝	234	143	47	29	58
¼x1—½x½	250	153	50	31	62
⅜x¾	281	171	56	35	70
½x⅝	312	190	62	39	78
⅜x1—½x¾	374	228	75	47	93
⅝x⅝	390	238	78	49	97
½x1	500	305	100	62	125
¾x¾	562	343	112	65	140
½x1½—¾x1	750	457	150	93	187
1x1	1000	610	200	124	250
¾x1½	1125	686	225	139	281
¾x2—1x1½	1500	915	300	186	375
1x2	2000	1220	400	248	500
1½x1½	2250	1373	450	279	562
1x3	3000	1830	600	372	750
2x2—1x4	4000	2440	800	496	1000

Round Conductors

Dia.	*Copper*	*Alum.*	*Brass*	*Iron*	*Phos. Bronze*
1/16 dia.	3	2	½	½	1
3/32	7	4	1	1	2
⅛	12	7	2	2	3
5/32	19	12	4	2	5
3/16	28	17	6	3	7
¼	49	30	10	6	12
5/16	77	47	15	10	19
⅜	111	68	22	14	28
7/16	150	92	30	19	37
½	196	120	39	24	49
⅝	307	187	61	38	77
¾	441	269	88	55	110
⅞	691	367	120	75	173
1	785	479	157	97	198
1¼	1228	748	246	152	307
1½	1764	1076	353	219	441
1¾	2404	1468	480	298	601
2	3140	1916	628	380	785

TABLE 2—METALS FOR VARIOUS PLATING BATHS

Kind of Plating	*Rack Metal*	*Tip Metal*
Acid Copper	Copper or Brass	Monel, Copper, Brass
Cyanide Copper & Brass	*Iron or *Copper	*Phosphor Bronze, *Steel, Brass
Gold, Indium, Rhodium, Platinum	Brass or Steel	Stainless Steel, Nichrome
Iron (Ferric Chloride Solution)	Heavy Copper	Copper, Everdur Bronze (exposed tips lead coated)
Lead Fluoborate (Copper Sulphate Solution)	Copper	Monel, Bronze, Copper, Brass
Dull Nickel	Brass or Copper	Brass, Copper, *Bronze
Bright Nickel	Copper	Brass, Copper, *Bronze
Silver	Brass, Nickel or Steel	*Steel, *Stainless Steel, Nichrome
Tin	Brass or Copper	*Phosphor Bronze, Brass, Copper
Acid Zinc	Brass or Copper	*Bronze, Copper, Spring Brass
Cyanide Zinc	Copper	Steel, Bronze
Cadmium	Brass or Copper	Steel, Bronze
Chromium	Copper (heavy)	Spring Bronze
Anodizing	24 or 17 ST heat treated aluminum	Spring Aluminum usually non-removable

* Kind of metal recommended

All Data from "Plating Rack Manual," by Wm. E. Belke

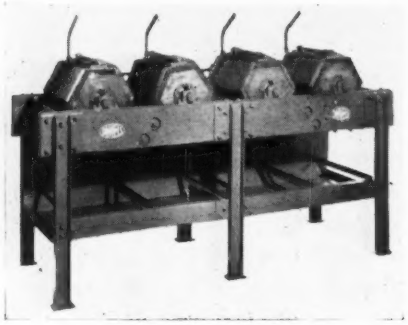
Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Multiple Tumbling Barrel

Daniels Plating Barrel and Supply Company, Dept. MF, 129 Oliver Street, Newark 5, N. J.

A multiple tumbling and burnishing barrel unit is being manufactured and marketed by the above firm. This unit has been designed for economy, flexibility, durability, simplified operation, and minimum installation costs, according to the firm.



The framework is constructed of well-seasoned cypress and supported by channel iron legs. Its simplified design readily lends itself to inexpensive tumbler additions or dimensional changes in cylinders. The unit is chain driven by a single constant or variable speed reduction motor, yet each cylinder is individually controlled with a hand-operated friction clutch.

This machine is made in multiples of two cylinder units, complete with drain pans and outlets for rapid waste removal. It can also be furnished with separated trays for separating work from the tumbling medium.

The simplified design of this versatile tumbling barrel unit makes it reasonably priced, as well as reducing maintenance and installation costs, it is claimed.

Nylon Anode Bags

Enthone, Inc., 442 Elm Street, Dept. MF, New Haven, Conn.

This firm has announced the development of a new Nylon anode bag to cover nickel, copper, silver, zinc and other metal anodes used in electroplating solutions.

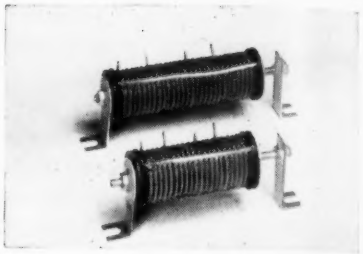
The anode bags are made of sturdy Nylon of 66 x 48 weave and are stated to be over 50% stronger than comparable cotton bags. Tests have indicated that the strength of these bags is maintained in both acid and alkaline solutions at temperatures up to 150°F. for long periods of time, it is claimed. When put in a bright nickel plating solution operating at a pH of 3.5, after two months of immersion no measurable change in bursting strength or tear strength could be determined, according to the firm. The bags are ordinarily supplied 4" longer than the length of the anode to allow accumulation of sludge, and a nylon draw cord is also provided.

The cost of the bags is stated to be equal or less than comparable cotton bags.

High-Voltage Selenium Rectifier Cell

General Electric Co., Dept. MF, Lighting & Rectifier Div., Schenectady 5, N. Y.

A new high-voltage selenium rectifier cell designed to permit the use of a smaller stack to achieve the same wattage output has been announced by General Electric's Lighting and Rectifier Divisions.



Rated at 18 volts d-c output, a 50 per cent increase over low-voltage cells, the new high-voltage cell can be used in rectifier stacks for installations where space is limited and where the stack will not be required to operate continuously 24 hours daily for long periods.

An evaporation process which provides a uniform coating of selenium on each cell assures uniform characteristics of operation in electrical equipment requiring d-c power, it is claimed.

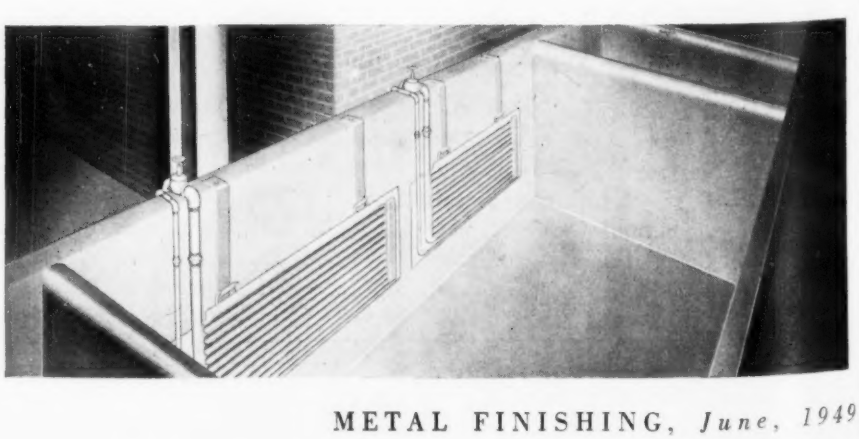
Bulletin GEA-5280, describing these new cells, is available on request to the above address.

Plate Type Heat Transformer Coils

Udylite Corp., Dept. MF, 1651 E. Grand Blvd., Detroit 11, Mich.

A new type heating and cooling coil for plating, degreasing, pickling and anodizing tanks which obsoletes conventional pipe coil is announced by the above firm.

The patented design of embossed metal plates permanently welded together is claimed to have many important advantages, such as higher BTU capacity per square foot of area, rapid even heat transfer, small coil space, easy installation, low maintenance cost and lower initial cost. Either heating or cooling can be done



with these new coils which fit practically every size and design of tank.

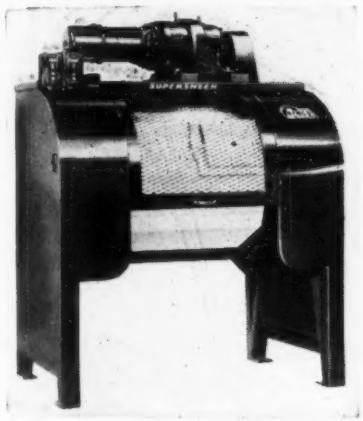
Because of its generous passage for the heating or cooling agent, and its high ratio of prime surface, the Udylite Platecoil develops an extra high rate of heat transfer, it is claimed. For this reason, less plate area is required than with conventional pipe coil.

Very often stray currents or unaccountable chemical reactions quickly deteriorate a coil to uselessness. Pipe coils must be removed, cleaned, welded and patched by expensive labor during shut down. These new coils can be removed and replaced by new Platecoils without shutdown at a cost comparable to the labor necessary to repair old pipe coils, it is claimed.

Udylite Platecoils are available in three metals—cold rolled steel, stainless and Monel—and two styles.

Deburring and Finishing Barrel

Almco Division, Queen Stove Works, Inc., Dept. MF, Albert Lea, Minn.



The above manufacturers have just announced their new deburring and finishing barrel, Model DB-200, that offers greater versatility, maximum safety, and maximum ease of operation, it is claimed. The manufacturer reports that before putting this model into regular production schedule, it was thoroughly tested on a wide variety of deburring and finishing work.

Many exclusive features distinguish this new model. Barrel speed is variable at a rate of from 6 to 30 R.P.M., which provides the exact rate for each specific job. Maximum safety is assured with a rollaway perforated hood, which permits positioning of barrel with the hood down. There are no protruding parts or door handles. The barrel itself is light-colored which al-

lows the operator better working vision.

Ease of operation is assured with a positive magnetic break that allows inching the barrel into position. Doors are cam-operated for quicker opening and quicker closing. Two safety switches are provided—forward and reversing.

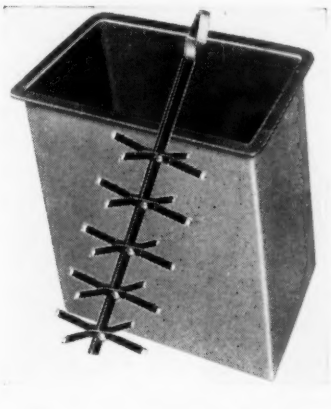
This new model is available with Neoprene lining or unlined.

Almco maintains a network of free Engineering Clinics for sample processing. Each of these clinics duplicates actual shop conditions and has proven to be an authentic source of complete data on production costs and procedures.

Coating for Plating Racks

Belke Mfg. Co., 947 North Cicero Avenue, Chicago 51, Ill.

An improved coating that combines



extraordinary resistance to corrosive solutions with toughness and high adhesive strength is announced by the above firm.

Known as Belke Universal Plastic, the coating remains resilient and pliable in service, it is claimed. It bonds to metal surfaces in a union that is stronger than the coating and impervious to penetration by liquids, according to the firm.

The surface of the coating is smooth, non-porous and pit-free, lessening drag-out and contamination of plating solutions.

The coating is composed of 100% solids; no thinners, reducers, or solvents are used in applying it. One dip forms a heavy coating of uniform thickness which is heat cured at temperatures above 350° F. The coating does not soften in hot plating solutions, it is claimed.

Developed through research and ex-

perimentation primarily for plating rack service, the coating is also giving good service on tanks, dipping baskets, pipes, fittings, valves, and other equipment requiring protection against corrosion, according to the manufacturer.

It is applied by the manufacturer, or may be purchased for application by the user. Complete information furnished promptly on request to the manufacturer.

Semi-Automatic Polishing and Buffing Machines

Hammond Machinery Builders, Dept. MF, 1601 Douglas Avenue, Kalamazoo, Mich.

Four new 2-spindle, manual-indexed, semi-automatic polishing and buffing machines have recently been announced by Hammond.

These new machines, used in conjunction with any lathe or contour machine, will pay for themselves in 3 to 6 months through increased production and better finishes, it is claimed.

Simplicity of new "Unit" design and other features make them versatile in operation on such parts as hub caps, pots, pans, lamp bodies, towel rods, plumbing fixtures, etc.

Polishing or buffing with wheels or abrasive belts and backstands can be efficiently accomplished with these Hammond Semi-Automatics by inexperienced operators, according to the firm.

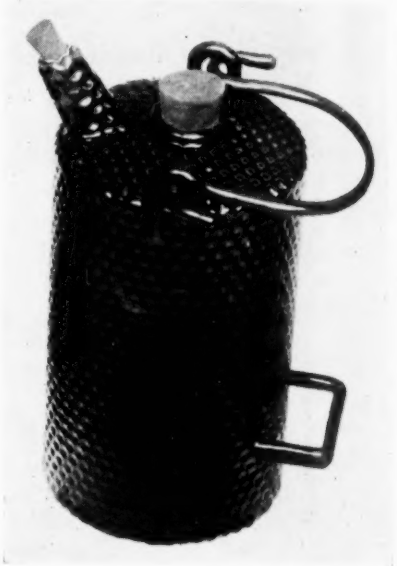
Other semi-automatics of the single-spindle type and four spindle power-indexing type are also included in the company's complete line of machinery.

Spill-Proof Unbreakable Acid Container

Automotive Rubber Co., Dept. MF, 8601 Epworth Blvd., Detroit 4, Mich.

A new closed-type unbreakable container for carrying acids, alkalis and other corrosive solutions without danger of spilling is announced as available in 1, 3, and 5 gallon sizes.

The manufacturers advise that the



new container is constructed similar to their other solution handling utensils with perforated steel shell sandwiched between 1/8" coatings of seamless rubber or synthetics, according to need.

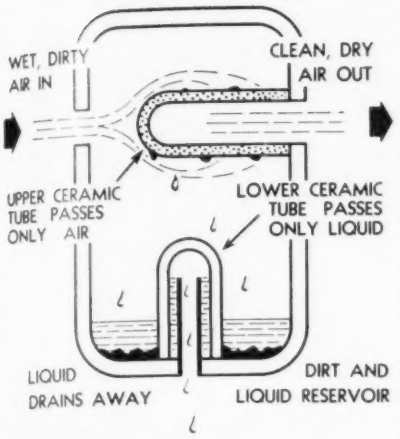
Inner and outer coatings are tied through the perforations for permanent adherence and leave no metal exposed. Both carrying and tipping handles are covered and rubber stoppers for top and spout are included.

Line Filters for Air or Gas Lines

Selas Corp. of America, Dept. MF, Erie Ave. and D St., Phila. 34, Pa.

Water and water-oil emulsions are removed automatically and continuously from compressed air or gas lines by the newly designed Liqui-jector it is claimed. Typical applications are in liquid separation, agitation, drying, spraying, instruments, and pneumatic mechanisms.

Phase separation and liquid ejection are accomplished by two ceramic tubes; one water-repellent, the other water-permeable but air-impervious. Compressed air or other gas passes through the first tube where it is stripped of its aqueous contamination



and dirt. Moisture drops to the bottom and drains through the second tube without loss of air. The water ejection rates for the three sizes of the equipment vary from 0.5 to 2.5 gallons per 24 hours. The Liqui-jector acts also as a filter, removing atmospheric dirt and finely divided solid particles, even finer than 100 microns in diameter, according to the firm.

The housing of the Liqui-jector is cast bronze. There are no moving parts, traps, cocks, or shutoffs. Maintenance is limited to periodic inspection and removal of accumulated dirt.

Chromate Dip To Prevent Tarnishing of Plated Surfaces

Jacob Hay Co., Dept. MF, 4014 W. Parker Ave., Chicago 39, Ill.

It was recently announced by the above firm that a new chromate-type dip coating has been developed which will prevent tarnishing of plated metal surfaces. This new bath for dipping metal parts is called "Hay Glo-Dip" and offers superior results for the bright dipping of plated metal parts, it is claimed. In addition to its non-tarnishing properties, it is also claimed to offer an excellent pre-surfacing treatment prior to painting metal parts. The firm also manufactures a brightening agent for cyanide cadmium plating baths, making possible the production of brilliant deposits directly from the bath, it is claimed.

Further information on these two materials may be obtained by writing to the above address.

Abrasive Belt Grinder

Pacific Abrasive Supply Co., Dept. MF, 900 East 9th St., Los Angeles 21, Calif.

The Burrmaster, a new abasive belt grinding unit, has been announced by

this firm. Advantages cited for this unit are as follows:

Has unlimited uses for grinding, deburring, polishing metal, wood and plastics.

Eliminates set-up wheels and grinding wheel dressing by using long-wearing, low-cost coated abrasive belts in standard sizes.

Is adaptable as tool post grinder on engine lathe for roll grinding and polishing.

Rubber contact wheel provides proper support for coated abrasive.

Precision engineered for smooth operation at 6500 SFM.

Strong, all metal construction; belt tension provides accurate adjustment to suit operator's needs; quick, easy belt changing.

The total weight of the unit is 25 lbs. Weight, bench assembly with motor, 60 lbs. Dimensions: Overall height 24″; overal depth 18″; overall width 6½″; contact wheel (Neoprene rubber coated) 7″ diameter, 1½″ wide, ⅝″ arbor hole.

Back Stand Idler With Hydraulic Belt Tension Control

Niederst Company, Dept. MF, 525 West 76th Street, Chicago, Ill.

In keeping with their policy of offering the most advanced methods for obtaining better finishes through the belt polishing method, the above firm has recently announced that in the future a new belt-tension control will be an included feature of their versatile, light-weight back stand idler.

Revere to Make Plater's Bar

Introduction of plater's bar, a highly refined and closely processed product used in the jewelry trade by manufacturers of rolled plate, is announced by *Revere Copper and Brass, Inc.*

New and modern equipment recently installed in the Revere New Bedford mill makes possible this addition to the company's line of copper and brass products. The bar is available in a complete range of sizes and a wide variety of copper alloys. The base metals are supplied in shades to complement the precious metals with which they are clad by the plate manufacturers.

Burnishing Aluminum and Stainless

M. & M. Chemical Co., Dept. MF, P.O. Box 172, Willimantic, Conn.

The above firm announces two new materials; one is called Marco No. 112 and is used in bright burnishing aluminum alloys, and the other, Marco No. 110, is for burnishing stainless steels. According to the firm, outstanding results are possible on these metals, which are normally quite difficult to burnish satisfactorily. Sample quantities in gallon sizes are available at nominal cost as an introductory offer.

Self Contained Packaged Plating Machine

W. S. Rockwell Company, Dept. MF, 200 Eliot St., Fairfield, Conn.

The Cro-Plater pictured above is a complete plating unit, fully wired and ready for operation on delivery. There are no installation troubles or expenses beyond the supply of current to the machine, according to the firm.

This new machine is designed primarily for all types of chromium plating. It is provided with a lead-lined Armco iron tank. It can deliver any required amperage up to 300 amps. under precision control not only of current, but of temperature. The unit is equipped with a blower which not only exhausts the fumes from the tank, but force-cools the copper oxide rectifiers.

The Cro-Plater can be used for

other metals besides chromium, where the standard lead-lined tank is suitable. Plain steel, rubber-lined or other types of tank construction can be provided in special units.

One of the most important fields of application, particularly for chromium plating, is the small shop, where the facilities it provides for precision work, readily duplicatable, are of great promise. It will also find a large field of usefulness in large plants, not only for departmental plating work, but for special plating operations, including pilot plant and development investigations. It should find a ready place in plating research of all kinds, it is claimed.

The Cro-Plater is now made in one standard size, with a 45-gallon lead-lined Armco iron tank, 24" x 18" x 30", electrically heated by a thermostatically controlled unit, located outside and at the bottom of the tank. It requires a 220 volt, 3 phase 60 cycle, 50 ampere input. A bank of six force-cooled copper oxide rectifier stacks delivers up to 300 amperes at 1 to 15 volts for the plating operation.

Temperature Controller

Burling Instrument Co., Dept. MF, 253 Springfield Avenue, Newark 3, N. J.

This firm announces the introduction of a temperature control of extreme sensitivity and accuracy.

In a demonstration, a good size valve was moved 90° merely by the temperature change resulting from a hand grasping the brass tube of the

Burling Model D. As the tube started to cool off and the power of the valve operator began to return to its original position, the motion was halted merely by again grasping the brass tube with only two fingers.

This remarkable sensitivity is a result of the combination of the Burling Model D plus the Atcotran, a development of the Automatic Temperature Control Company, Inc. The instrument is recommended for extremely sensitive control of gas valves, dampers as well as anything controlled by a moving lever.

Illustrated literature is available.

New Plating Equipment for the Jewelry Trade

Hollywood Bronze Supply Co., Dept. MF, 1770 N. Vermont Ave., Hollywood 27, Cal.

There has been a growing demand in the jewelry trade for well-designed, small plating units for gold, silver and copper. Such units are now manufactured by the above firm. This company has recently expanded its engineering facilities under the direction of *George W. Slomin*, an electrochemist who has had many years of experience in the design and development of finishes and equipment for the jewelry trade.

Mr. Charles Auerbach, director of the organization, has announced that the new equipment possesses many engineering refinements heretofore unavailable except in the most expensive types of laboratory equipment. Tanks for gold and silver of two, eight, and fifteen gallon capacity are made entirely of 18-8- Columbium-bearing stainless steel. The gold tanks, which must be heated, are equipped with built-in electric heating elements attached to the rear wall of the tank. Wattage of the heating element is limited so that the plating solutions cannot be overheated, it is claimed.

Another outstanding feature is the swing-away work rod which is hinged to the tank in such a way that large parts may be put in the solution without danger of short circuiting. The company also manufactures prepared plating salts ready mixed for solution in water, which are time saving and require no mixing or weighing.

Rotary Wire Brushes

Hewitt Rubber Div., Dept. MF, Hewitt-Robins, Inc., Buffalo 5, N. Y.

A completely new rotary wire brush, with bristles imbedded or locked in rubber centers, has been announced by the above firm with the introduction this month of the new Hewitt Rubberlokt rotary wire wheel brush.

Ingenuity, perseverance, and a year of research is responsible for the development of the new brush, which marks an outstanding change in wire wheel brush construction, it is claimed. The combination of steel bristles mounted in rubber has produced a far safer brush, one which lasts longer and does a better job than other types, according to the firm.

Hewitt is presently producing six, eight and ten-inch industrial sizes, and and a bigger variety will be added to the line later. The brush can be used on either bench or portable tools, and its potential market includes all industries and shops where buffing, roughing or finishing with a wire brush is a part of the operation.

Thickness Measurement of Non-Magnetic Coatings on Steel

Branston Instruments, Inc., Dept. MF, 436 Fairfield Ave., Stamford, Conn.

The Coatingage, an instrument for measuring the thickness of non-magnetic coatings on iron or steel, has been announced by this firm.

Measurements are made rapidly, without damage to the coating, and the thickness is indicated directly on the meter of the instrument. Two concentric scales cover a range of 0.0001"-0.50". The instrument's lightweight and self-contained battery power supply permit its use in the field as well as in the laboratory or on the production line, it is claimed. Typical applications include the measurement of the thickness of paints, enamels, metal plating, protective coatings, scale or coke deposits.

Coating thickness is measured by the effect of changes in the reluctance of a magnetic circuit. When the coil is in direct contact with the base metal the

reluctance is low and the self-inductance of the coil is high. The bridge is then balanced for zero thickness. An increase in the gap between the coil and the base metal unbalances the bridge, and causes current to flow through the indicating microammeter.

The instrument is housed in a luggage-type carrying case, 8″ high, 9″ wide and 6″ deep, weighing 10 lbs. Power is furnished by two 67½ volt batteries and one 1½ volt battery, contained in the instrument. Thickness readings are within 10% of the actual thickness.

Metal Cleaner

Abbey Materials Corp., Dept. MF, 208 East 6th Street, New York 3, N. Y.

After several years of research, this firm announces the development of Hycleen "A," a new type of cleaner for metals.

It is a specially prepared soap and ammonia substitute, which can be operated at boiling, without any ammonia odor. Solutions are free rinsing and will not leave any lime soaps or hard water films on the work, it is claimed.

Hycleen "A" can be used to clean white metals such as cadmium-zinc, zinc-aluminum, or tin base alloys. It is not recommended for lead or lead base alloys.

Improved Bright Dip for Copper Alloys

Rossaul Co., Dept. MF, 170 Fifth Avenue, New York 10, N. Y.

This firm announces an improved Copper-Brite formulation that will lower drag-out by 50% and produce a brighter, passivated surface on these metals, it is claimed.

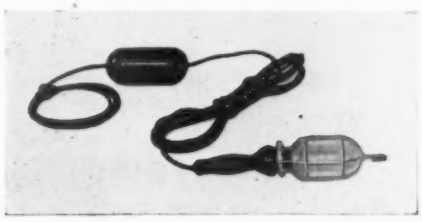
It dissolves oxides and fire scale, leaving the above metals in a bright passivated state, resistant to future oxidation, it is claimed. As it is non-toxic and non-fuming, special ventilation is not required, and it will not discolor silver solder, according to the manufacturer.

Packaged in one gallon bottles, five gallon demijohns and thirteen gallon carboys. Small metal items may be submitted for sample processing.

Low Voltage Trouble-Lamp

Etraco Mfg. Co., Dept. MF, Woods Church Rd., Flemington, N. J.

Lives will be saved by a new portable



safety transformer designed to safeguard industrial workers in damp or wet locations from the possibility of fatal electric shock while working with the conventional type of 110 volt extension trouble-lamp.

Callel SAF-T-LITE, the new device is described as a portable step-down transformer that will prevent death by electrocution often caused by the accidental grounding of portable extension trouble-lamps comonly used by men while working in boilers, tanks, vats, underground vaults and ships' holds as well as in damp factories, warehouses and cellars.

The portable safety unit weighs only 4¼ pounds and reduces a 110 volt circuit to only 6 volts, a voltage which is said to be harmless. Company spokesmen report that 6 volts is even lower than the recommended voltage for the operation of trouble-lamps in damp or otherwise hazardous locations where contact with a 110 volt lighting circuit might result in fatal shock.

Small in size, SAF-T-LITE looks like a large black capsule, the safety transformer being protected by a strong and water-proof bakelite casing tested to withstand extreme physical

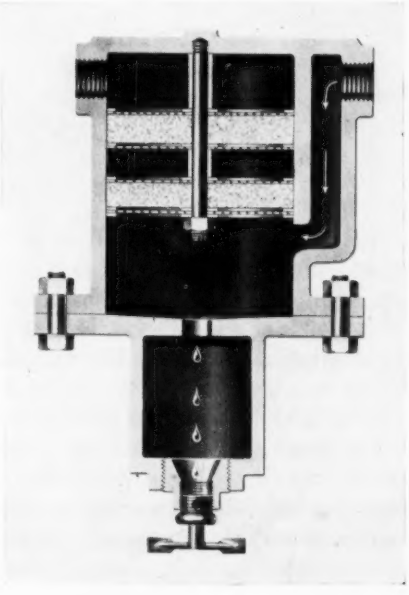
and chemical abuse. When connected to an outlet, the unit can be left on floor or table or it can be hung from any wall fixture by a convenient hook which protrudes from the top of the transformer.

Compressed Air Separator

James A. Murphy & Co., Dept. MF, Fifth & Vine Sts., Hamilton, O.

The separator shown here is designed to remove the last trace of oil, moisture and dirt from compressed air at the point of use.

Installed in the pipe line just ahead of the point of delivery, air enters the unit at the top right and enters the expansion chamber below the strainer cartridge, where expansion and surface contact separates air and moisture. The air then rises slowly through two cotton felt absorbant pads which trap the last trace of oil, grit and moisture, it is claimed.



Separated moisture drops to the moisture collector, where it is held separate from incoming air to prevent re-absorption. Moisture may be drained periodically by hand or the drain plug may be "cracked" to allow escapement of fluid without leakage of air.

The strainer cartridge may be removed, cleaned with solvent and reused.

The unit is offered in two sizes. Size No. 1 measures 5¼" x 8½" over-all, accommodates inlet and outlet pipe sizes of ⅛" to ⅜", delivers to one ⅛" pipe nozzle only.

Size No. 2 measures 6½" x 8½" over-all, accommodates inlet and outlet pipe sizes of ⅛" to ¾", delivers by manifold to four ⅛" pipe nozzles or to two ¼" pipe nozzles.

Spray Washers

Detrex Corporation, Dept. MF, Detroit 32, Mich.

A new series of metal parts washers feature standardized construction so that multiple wash, rinse and dry-off stages may be incorporated at minimum cost. They are designed so that if only spray stages are installed originally, a blow-off stage may be readily added at any time later, thus increasing the flexibility of such machines for a variety of production cleaning requirements.

These machines may be used as standard metal parts washers for ordinary alkali cleaning compounds, or may be easily converted in a matter of minutes to efficiently handle those compounds which have a tendency to foam excessively, it is claimed.

The work is pressure-sprayed with cleaning solution from rigidly supported multiple spray headers. Spray nozzles are readily accessible for cleaning, and are adjustable so that they may be directed to any given point—top, bottom and sides. All spray headers are provided with removable plugs for easy cleanout.

A conveniently located access door is provided for rapid cleanout or adjustment of parts. It is not necessary to enter the machine for cleanout purposes, according to the firm.

The blow-off stage, for both the

single and double-spray-zone machines, may be steam or gas heated, or built to give cold-air blast, whichever is required. The position of each blow-off nozzle is easily adjustable so as to strike the work at any angle desired to give most effective drying, it is claimed.

Business Items

Lea Adds New Warehouse Facilities

The Lea Mfg. Co., Waterbury, Conn., manufacturers of Lea Com-

pound, Learok and other finishing materials, has completed added storage and shipping facilities for the company's resale items. A new warehouse with railroad siding, as well as truck-loading and unloading platforms, was recently finished and is now operating in another section of Waterbury on a plot where the company is planning at a later date to build a new manufacturing plant. Main storage and handling of the resale items as well as the manufacture of Lea products are still carried on at the factory on Cherry Avenue.

Randall Moves to New Quarters

The Randall Mfg. Co., makers of engineered equipment for the plating and finishing industry, including degreasers, washing machines, tanks, agitators, driers, rectifiers and rheostats, announces that they have recently moved into their new plant at 801 *Edgewater Road, New York* 59, *N. Y.*

Osborn Holds Sales Meeting

New potentialities of the power-driven brush in the metal polishing field, and modern techniques and methods which present the brushing industry with one of its greatest opportunities to trim production costs, was the subject discussed by this group of company salesmen and executives at a recent meeting in the Cleveland headquarters of *The Osborn Manufacturing Co.*

Two Changes at Industrial Filter

Jack F. Brossart

Jack F. Brossart, until recently General Sales Manager of *Industrial Filter & Pump Mfg. Co., Chicago, Ill.*, has been appointed Pacific Coast Manager

Harold W. Faint

of the company. *Harold W. Faint*, who has been with the company since 1945 and recently Manager of the Ion Exchange Department, has been appointed General Sales Manager, succeeding Mr. Brossart.

Niederst Company Moves to Larger Quarters

The Niederst Company, manufacturers of back stand idling equipment for belt polishing, has recently moved to larger quarters in keeping with the demand for higher production facilities for the Niederst Back Stand Idler. The new plant will be located at 525 *West 76 Street, Chicago, Illinois*, in the center of an established industrial district.

One of the oldest firms in the field of abrasive polishing, the Niederst Company specializes in the manufacture of belt polishing equipment in which either contact wheels or buff contact wheels may be employed to render a superlative finish to metal products.

Armco Installs Fourth Continuous Coating Line

A fourth major unit for continuous production-line coating of flat-rolled steel in a bath of molten zinc or aluminum was put into operation in May by *Armco Steel Corporation, Middletown, Ohio*. The original unit went into production at Armco's Butler, Pennsylvania plant in July, 1936. During the last 13 years the company has sold its special zinc-coated product under the trade name Armco Zincgrip. Since 1939, the aluminum-coated sheet steel has been known as Armco Aluminized.

With the installation of the fourth unit at the Middletown plant, the patented coating process will be offered to other steel companies under license.

Manderscheid Appoints Representative

The *Manderscheid Company, of Chicago*, manufacturers and distributors of metal finishing supplies, announces the appointment of *Mr. Clay Sayers* to represent them in Indiana and Western Michigan.

Mr. Sayers started work in the metal finishing field in 1920 and has held positions as Foreman, General Fore-

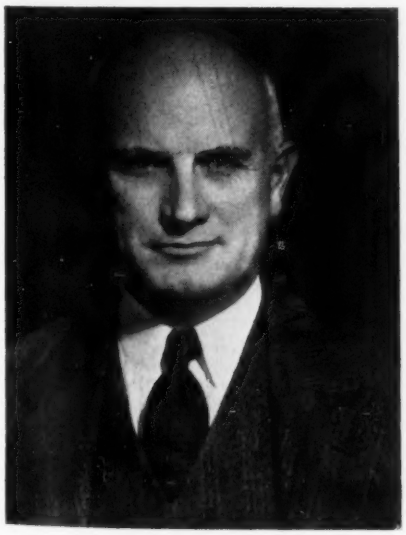
man and Superintendent with some of the country's largest metal working corporations. He entered the sales field a few years ago selling the metal finishing plants throughout a three-

Clay Sayers

state area. Due to Mr. Sayers' wide production experience, he has an excellent understanding of metal working problems and is in a position to offer helpful suggestions.

Pennsalt Elects Officers

George B. Beitzel was elected president of Pennsylvania Salt Manufactur-



George B. Beitzel

ing Company on the eve of its 100th anniversary year. The new chief executive joined the company 19 years ago and since Jan. 1, 1949, has served as executive vice president.

Leonard T. Beale, president for the last 20 years, will continue with the company as chairman of the board.

At its annual meeting the board also elected *William P. Drake* vice president in charge of sales, and *William F. Mitchell* vice president in charge of manufacturing.

Mr. Drake, formerly assistant vice president, sales, assumes the position left vacant when Mr. Beitzel became executive vice president. Mr. Mitchell, assistant vice president, manufacturing, succeeds Y. F. Hardcastle, who retires from active participation in the chemical company's operation but who remains as a member of the board.

Mr. Beitzel and Fred C. Shanaman, president of Pennsylvania Salt Manufacturing Company of Washington, wholly-owned West Coast subsidiary, were elected to two new directorships created at a recent meeting of the board. Mr. Shanaman also is a vice president of the parent company.

Dow Chemical Appoints New Sales Executives

Leland I. Doan, newly elected President of The Dow Chemical Company, has announced the promotion of *Donald Williams* from General Sales Manager to Director of Sales, the latter position having been vacated by Mr. Doan when he stepped into the presidency following the death of Dr. Willard H. Dow.

Mr. Williams in turn has announced the appointment of *Donald K. Ballman*, former Assistant General Sales Manager, to fill the position of General Sales Manager, and of *Dr. L. S. Roehm* to the post of Assistant General Sales Manager. Dr. Roehm has been in charge of Dow's Technical Service and Development Division and will continue also in this capacity.

New Firm in Hard Chrome Plating Field

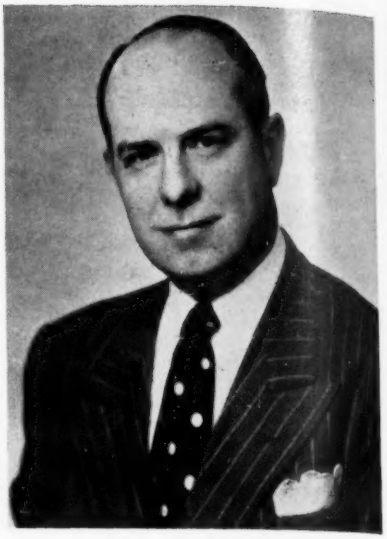
A new firm in the hard chrome plating of tools, dies, and machinery parts is the *Forpal Co., 139 Riverside Street, Oakville, Conn. Mr. Leo Forget*, the manager of the company, has had a long and varied career in the field, and the firm is equipped to render prompt and efficient service. The firm is also equipped to design and construct plating racks of all types, including the coating of racks with chemical resistant coatings.

F. D. Pace Enlarges Facilities

F. D. Pace, distributor of electroplating equipment and supplies, is now building an addition to their present factory at *69-73 Scribner Avenue N.W., Grand Rapids, Mich.* The new building will house the offices and laboratory in addition to the manufacturing and storage facilities. The firm is expanding its rack insulation and plastic insulation facilities, and the new addition will give them about 3600 sq. ft. of new floor space. The new building will be ready for occupancy in June.

Way Appointed Sales Manager for Nox-Rust

Appointment of *Fred L. Way* as Sales Manager of the Rust Prevention Division including the new Nox-Rust



Fred L. Way

Vapor Wrapper has been announced by *G. A. Daubert*, President, Nox-Rust Chemical Corporation, 2429 So. Halsted Street, Chicago 8, Ill.

Mr. Way is a graduate in Chemical Engineering at Ohio State University, and for the past 20 years has been associated in various executive capacities with the Freedom Valvoline Oil Co., most recently as manager of their Rust Prevention Division.

His Assistant Sales Manager is to be *Robert G. Clendenin*, who is a graduate in Chemistry from Kansas State College and has served Nox-Rust in various technical and sales capacities for seven years. Other appointments announced are *Carl E. Salzman, District* Manager of the Chicago area, and *D. K. Blankenship*, District Manager of an area comprising Ohio, Indiana, and portions of Michigan and Kentucky.

Son Succeeds Father as Osborn Representative

Appointment of *Gaylord L. Jones, Jr.*, as Osborn sales representative in the Southeastern area, to succeed his late father, who died last New Year's Day, was announced by *Robert Wier, Jr.*, General Sales Manager of the Brush Division of The Osborn Mfg. Co., of Cleveland, Ohio.

Gaylord, Jr., will serve the area including Florida, Southern Georgia and Alabama, Mississippi and lower Louisiana, developed by his father over a period of 16 years of service with Osborn's Brush Division.

A New Metal Spraying Shop

L. O. Koven & Brother, Inc., Jersey

City, N. J., manufacturers of boilers, tanks, special process equipment and weldments, announces the addition of a metal spraying shop to its plant facilities at Jersey City.

The shop, equipped with the latest metal spraying equipment, is set up for surfacing of any metal with lead, zinc, babbitt, tin, copper, nickel, carbon steel, stainless steel, Monel, etc.

This process is applicable for the surfacing of shafts, spindles, bearings and bearing surfaces, tanks, patterns, cores and other assemblies and structures.

American Nickeloid Appoints West Coast Representative

American Nickeloid Co. announces the recent appointment of *George A. Spencer* to head its Los Angeles sales office. As new west coast sales representative, Mr. Spencer will be located at 1323 Venice Blvd., Los Angeles 6, California.

Manufacturer of pre-plated metals celebrating its 50th anniversary last year, American Nickeloid Co. is widely represented through 16 sales branches in this country and Canada. Home office and plant is located in Peru, Ill., with a considerable portion of the manufacturing carried on at the Walnutport, Pa., branch plant.

Pennsalt Makes Changes in Sales Personnel

The appointment of *Albert H. Clem* as assistant manager of sales of the Special Chemicals Division, Pennslyvania Salt Mfg. Co., was announced recently.

Clem, who has been field sales supervisor of the division, also will assume the duties formerly performed by *Philip C. Staples, Jr.*, as product supervisor on cleaners. Staples has been transferred to the company's Heavy Chemicals Division as a product supervisor.

Albert H. Clem

Price Reductions on Tygon Paint

Effective immediately, *The U. S. Stoneware Co., Akron, Ohio*, announce price reductions on their Tygon Paints. These cost reductions are made possible by a decline in some raw material prices.

At the same time the firm announces a number of new product developments which will extend the usefulness of Tygon Paint to a much wider range of applications. Most of these new developments have to do with new primers which offer better adhesion to difficult surfaces and eliminate the tendency of corrosion to creep underneath a solid appearing film.

TP-111 Wash Primer—Developed primarily to permit easier application of Tygon Paints to difficult surfaces such as aluminum, galvanized iron and steel, magnesium, zinc, stainless steel and other alloys, and to damp concrete, this new prime system is so effective it can be used on surfaces impossible to sand blast or prepare as normally recommended. Tygon Wash Primer etches as it primes. It actually bites into metal or concrete surfaces to provide maximum adhesion, it is claimed.

In order to familiarize users with

the new developments in Tygon paints, this firm has prepared a test kit which includes:

1 pint TP-111 Wash Primer Solutions No. 1 and No. 2.

¼ pint TP-113 Wash Primer Thinner.

1 pint TP-108 Red Primer.

1 pint TP-110 Concrete Primer.

1 quart TP-12 Light gray top coat.

1 pint TP-91 Thinner.

This kit may be ordered from the above address at a very nominal sum.

American Cyanamid Makes Executive Appointments

The American Cyanamid Company announces the appointment of *Mr. C. F. Bonnet* as Production Manager of its Industrial Chemical Division, and *Mr. G. W. Russell* as Assistant Sales Manager of the same division.

Mr. Bonnet, who has been with Cyanamid for more than 15 years, formerly served in the capacity of Assistant General Sales Manager of the Industrial Chemical Division.

Mr. Russell, prior to his new appointment, has been Manager of the New Products Development Department, and in his new capacity will take over the sales duties previously handled by Mr. Bonnet.

Dow Chemical Makes Shifts in Top Executive Staff

Several shifts in the top executive staff of *The Dow Chemical Company* were made recently by the company's Board of Directors as a result of the death March 31 of *Dr. Willard H. Dow* in a plane crash near London, Ontario, which also took the lives of his wife and three other persons.

Earl W. Bennett, Treasurer of the company since 1930, was elected Chairman of the Board, and *Leland I. Doan* was elected President of the company. Mr. Doan had been a Vice President since 1938 and Secretary since 1941.

Dr. Mark E. Putnam, a Vice President since 1942, was named General Manager.

Dr. Dow had formerly held all three of the positions thus filled but in recent years had abandoned the titles of Chairman of the Board and General Manager.

In the same action two new Vice Presidents were named: *Dr. A. P. Beutel*, who is General Manager of Dow's Texas Division, and *Russell L. Curtis*, General Manager of the Great Western Division. *Carl A. Gerstacker* was elected Treasurer and *Calvin A. Campbell*, the firm's legal counsel, was elected Secretary.

Diversey Purchases Stock of General Reduction Co.

The *Diversey Corp.*, Chicago, a leading firm in the field of industrial chemicals, cleaning compounds, disinfectants, and insecticides—has purchased all common stock of *General Reduction Company, Macon, Ga.*

Close to 50 years old, General Reduction Company mines, processes and markets decolorizing and oil absorbent minerals. The company owns and operates a 1500-acre mine in Pike's Peak, Ga., as well as a heat-treating and processing plant in Macon.

Charles E. Glasser, treasurer of the Diversey Corporation, has been elected president of General Reduction Company. *James Slocum*, former general manager, has been retained in the capacity of vice president. *F. E. Horn* is secretary and *E. A. Naughton*, treasurer. Diversey will continue operating the company along present lines while installing additional equipment to broaden its scope.

General Reduction Company is one of the oldest and largest firms supply-

ing minerals for declorizing and purifying animal, vegetable and mineral oils. Sales are mainly to manufacturers of food products, soaps and cosmetics, dry cleaning establishments and water purification works.

Lockman to Manage Tank Lining Sales for U. S. Rubber

Appointment of *Edward L. Lockman* as manager of tank lining and roll covering sales for United States Rubber Company was announced recently by *Frank M. Urban*, merchandise manager of the company's mechanical goods division.

Mr. Lockman, a graduate of Massachusetts Institute of Technology, is a veteran of 15 years with the rubber industry. He joined U. S. Rubber in August, 1934, as a salesman in New York. In 1938 he became assistant sales manager of roll covering and tank lining.

From 1942 to 1945 he served in the U. S. Army, attaining the rank of captain. He returned to his position as assistant sales manager of roll covering and tank lining sales in December of 1945.

Pennsalt Adopts New Container for Cements

A new composite container, designed to insure the maintenance of high quality through extended storage periods, has been adopted by the Special Chemicals Division of *Pennsylvania Salt Manufacturing Co., Phila, Pa.* for its corrosion-resistant synthetic resin-type cement powders.

Described as an improvement over other type drums when large quantities of resin cement powders are to be stored after having been opened, the inside of the fiber drum is coated with plastic wax. This, in turn, is protected by a polyethylene bag liner .002 of an inch thick. The cement is poured into the bag. An airtight condition is obtained by a lever lock device that clamps the metal top, also covered with polyethylene, to the drum.

For the present, Pennsalt is using these drums for its cements in 15-gallon and 41-gallon sizes.

New Consulting Firm in Corrosion Field

Kenneth Tator Associates, Montour Street, Ext., Coraopolis, Pa., has been organized to provide industry with impartial surveys, analyses, recommendations, and supervision of corrosion control methods and materials.

This firm is qualified to identify the various corrosion sources within any industrial plant or operation, and to draw up detailed specifications for the protection of the equipment and structures.

Its principals have many years experience in engineering and putting into successful operation maintenance and production lining shops for larger manufacturing companies.

Kenneth Tator, a well-known corrosion and registered chemical engineer, was formerly president of Industrial Lining Engineers, and still serves that company in a professional capacity. He is chairman of the Technical Committee on Protective Coatings of the National Association of Corrosion Engineers, and was a pioneer in the application of vinyl plastisols to corrosion prevention, and developed many other corrosion protection methods. His experience is complemented by the experience of his associates in corrosion metallurgy, cathodic protection, and corrosion testing.

Complete facilities for research and testing are maintained.

Bristol Appoints Akron District Manager

J. H. Ferguson has been named dis-

trict manager of the Akron, Ohio, branch office of *The Bristol Company*, Waterbury, Conn., according to an announcement by *H. E. Beane*, General Sales Manager.

A graduate from Pennsylvania State College with a degree of B. Sc. in Industrial Engineering in 1921, Mr. Ferguson was associated, following graduation, for a year and a half with the Western Electric Corporation in Philadelphia before joining the Bristol sales organization in 1923 as sales engineer. Since 1940, Mr. Ferguson has been connected with Bristol's Washington, D. C. Office.

His new headquarters will be at the company's Akron Office located at 727 *Grant St., Akron* 11, *Ohio.*

Weppner to Sell Pennsalt Cements and Paints

The appointment of *Richard A. Weppner* to the sales staff of Pennsylvania Salt Mfg. Co.'s Special Chemicals Division, was announced today by *Joseph J. Duffy, Jr.*, sales manager of the division.

Weppner, who for two and one-half years during the war served as chairman of the chemical branch of the War Production Board's Conservation Division, will take over active sales work in the east on Pennsalt corrosion resistant cements and paints.

A native of Cleveland, Weppner was graduated from the University of Notre Dame with a B. S. degree in chemistry and an M. S. degree in physical chemistry. He joined Pennsalt in March 1949.

DuPont Discontinues Sodium Hydride Manufacture

The E. I. Du Pont de Nemours Company has recently announced that it has discontinued the manufacture of sodium hydride and has licensed *Metal Hydrides, Inc.*, of Beverly, Mass., to manufacture it under Du Pont patents. Sodium hydride is used in various industrial chemical reactions, particularly in the manufacture of certain pharmaceuticals.

Du Pont said the agreement with Metal Hydrides has no bearing whatever on Du Pont's sodium hydride metal descaling process where the hydride is formed within the process from metallic sodium and hydrogen.

Pennsalt Fluorine Chemical Plant Nears Completion

The first operating phase of Pennsylvania Salt Mfg. Co.'s new fluorine chemical plant here will begin next month, it was announced today by *George B. Beitzel*, company president.

Under construction for approximately a year, the new $2,000,000 Calvert City Works will be devoted in its initial stages to the production of sulfuric acid and hydrofluoric acid. Plans call for future expansion that is expected to make this plant one of the largest in the Pennsalt chain.

James McWhirter, formerly superintendent of Pennsalt's Natrona, Pa., plant, is in charge of the new operation.

Imperial Purchases Rack Firm

Mr. E. L. Faulman, President of *Imperial Plating Rack Company*, 800 Industrial Ave., Flint, Michigan, announces the purchase of the firm formerly known as *Plating Racks, Inc.*, of Jackson, Michigan.

The Imperial Plating Rack Co. has been fabricating and servicing plating and anodizing racks for many midwest firms. The increased facilities made possible by this consolidation will enable the company to widen its scope of operations, and it welcomes inquiries from customers who have in the past purchased racks from Plating Racks, Inc.

Obituaries

Floyd F. Oplinger

Floyd F. Oplinger, manager of electroplating service and development in the E.I. Du Pont Company's Electrochemicals Department, and nationally known in the electroplating field, died on May 9th in the Chester County hospital, West Chester, Pa. He had been ill about three weeks.

Mr. Oplinger was born in Danielsville, Pa., in 1898. He attended Albright College for two years, and was graduated from Franklin and Marshall College in 1919 with a bachelor of science degree in chemistry. Three years later he received a master of science degree in chemistry from the University of Rochester. Later he was a chemistry instructor at the University of Rochester and the University of Maine.

In 1927, Mr. Oplinger went to work for the Roessler & Hasslacher Chemical Company as a chemist. Three years later, Du Pont acquired Roessler & Hasslacher, and the following year Mr. Oplinger was transferred to the New York office as a service representative on sodium and cyanide products.

Since 1933 Mr. Oplinger has held a variety of positions in the fields of metal treatment and electroplating, both at the Du Pont laboratory in Niagara Falls and in Wilmington. In December, 1945, he was appointed manager of electroplating service and development. A number of patents have been granted on Mr. Oplinger's inventions in the field of electrodeposition of metals, and he was the author of numerous articles on this subject.

Mr. Oplinger is survived by his wife and five children.

Carl Dennis

Carl Dennis, 72, superintendent of the plating supply manufacturing division of the Los Angeles Chemical Company, died at Los Angeles February 25 after a prolonged illness, during the last month of which he was confined to a hospital.

He is survived by his wife, Mrs. Mattie Dennis, who also was gravely ill at the time of her husband's death; and a nephew, Edwin Dennis, of Kansas City, Kansas.

Funeral services were held February 28 in the Wee Kirk of the Heather, Glendale, Calif., with cremation following at Forrest Lawn Cemetery. Attending the services were a number of the members of Los Angeles Branch of the American Electro-Platers' Society, of which he had been a member for the past 18 years.

Mr. Dennis was born in Olathe, Kansas. For a number of years he was associated with the Matchless Metal Polish Company, Glenridge, N. J., as vice president. He transferred his activities to Los Angeles in 1927 and joined the staff of the Los Angeles Chemical Company. He initiated the manufacturing of buffing and coloring compositions for that firm. At the time of his death he was general foreman of all plating chemical and compound activities for the company.

Charles A. Seaman

Mr. Charles A. Seaman, the Flint, Michigan representative of the Nelson Chemicals Corp., died on May 2nd. Mr. Seaman will be greatly missed by his many friends and business associates in the industry.

Manufacturers' Literature

Selenium Rectifier Bulletin

Rapid Electric Co., Dept. MF, 2847 Middletown Road, Bronx 61, N. Y.

The above firm has recently published a new bulletin describing their line of selenium rectifiers for plating and other industrial applications. Sizes available range from a small 5 amp output unit to large units of 2000 amps output. Also included is a description of their Reverse Current rectifiers and controls. Units up to 500 amp output at 6 volts are available, complete with timing controls as well as voltage and current controls. Both bench and floor models are manufactured by this firm, and all equipment incorporates the most modern and rugged construction. Copies are available on request to the above address.

Walrus Hide Polishing Wheels

Greene, Tweed & Co., Dept. MF, North Wales, Pa.

This firm has just issued a technical bulletin describing the uses and advantages of walrus hide leather polishing wheels. This type of wheel has been used for many years in the silverware industry for producing the highest quality finishes, and during the war was also widely used for the finishing of precision parts. Walrus hide is ideally suited to this type of work because of its tough, fibrous structure and resiliency, it is claimed, which give it extreme wear resistance combined with the ability to hold on to abrasives for long periods.

The bulletin gives details for setting up walrus hide wheels, together with suggested uses, wheel speeds, etc. Copies of this bulletin may be obtained by writing to the above address.

Resistance of High Nickel Alloys to Sulfuric Acid Corrosion

International Nickel Co., Dept. MF, 67 Wall St., N. Y. C.

A new technical bulletin on the resistence of high nickel alloys to corrosion by sulfuric acid has been issued by the above firm.

While the bulletin is technical in nature, it is written so that it can be readily understood by non-technical

as well as technical staffs of industries in which corrosion by this useful but highly corrosive agent is a problem.

Performance of over 30 different nickel-bearing materials in a wide range of services is discussed. Prepared by members of the Company's Corrosion Engineering Section, the bulletin contains 86 tables and 33 graphs and photographs in addition to text matter.

Problems involving such a wide range of operations from the pickling of steel to petroleum refining and textile processing are discussed. Known as Technical Bulletin T-3, it is available without cost.

Line Filters and Spray Nozzles

Yarnall-Waring Co., Dept. MF, Chestnut Hill, Philadelphia 18, *Pa.*

A bulletin issued recently by this firm illustrates and describes their line of spray nozzles and line filters. The line filters are used to screen dirt, chips, etc., from air and steam lines, preventing their fouling up steam traps and other control equipment. Spray nozzles are available in many types of spray patterns and sizes, and feature renewable orifices.

Copies of the bulletin are available on request.

Controlled Neutralization of Wastes

Leeds & Northrup Company, Dept. MF, 4934 *Stenton Avenue, Philadelphia* 44, *Penna.*

To show how numerous steel mills, metal-working shops, oil refineries, chemical works and other plants are effectively combating stream pollution through the use of standard pH equipment which automatically controls the neutralization of waste, the above firm has just published a 20-page, fully-illustrated bulletin.

This completely new publication describes a unique "controllability analysis" by which L&N engineers are advising management in advance whether waste pH can be kept within prescribed limits . . . or what treating system layout, or modification of existing layout, will be required. This bulletin also explains how the equipment continuously regulates the addition of reagent to raw waste so that pH is held within the limits predicted.

Described and pictured are the two

available control systems—Micromax Electric and Micromax Pneumatic Control—either of which is highly flexible in meeting the specific needs of almost any plant, according to this firm. The bulletin also tells how both control systems correctly proportion reagent flow to waste demand . . . whether that demand is due to concentration of acidity or to volume of waste. Illustrations show actual installations and pH control records being obtained.

A copy of Bulletin ND44-96-708 will be sent upon request.

Industrial Thermometer

W. C. Dillon & Co., Inc., Dept. MF, 5410 West Harrison St., Chicago 44, Ill.

A new Bulletin has just been issued on the Dillon stainless steel thermometer. The instrument covers practically every industrial use it is claimed, with features not found in usual fluid or expansion types. It comes in 5", 3", 2¼" and 1" dial sizes and stem lengths from 4" to 42". Especially noteworthy is its large heat-resistant dial, easily read from considerable distance. Standard calibration is in the Fahrenheit scale, but Centigrade ranges are available. Overall metal construction eliminates breakage, and the unit is safely used under conditions of severe vibration, corrosion or shock, it is claimed. It may be placed directly into hot materials without pre-heating, works equally well with liquids or gases, can be screwed into tanks, kettles, steam lines, exhaust systems, air ducts, boilers, refrigerators. Using a cork, it may be floated in open tanks. With long stem length, it checks deep vats where there is heat variation from top and bottom. Bulletin will be sent on request.

Protection of Metal Equipment Against Corrosion

Carboline Co., Dept. MF, 7603 Forsythe Blvd., St. Louis 5, Mo.

"How to Protect and Repair Metal Equipment for Corrosive Service" is the title of a bulletin issued for the use of design, process, plant and maintenance engineers.

The repair of equipment which has been cracked, broken or corroded, and the protection of new equipment for corrosive service, by means of special resins, are taken up step by step and fully illustrated.

The materials which make such repairs and corosion proofing possible are five new thermosetting resins. These resins are used as repair cements, coatings or casting compounds and thus are adaptable to practically any equipment corrosion proofing or repair service. Special fillers can be used to give these resins greater than normal heat transfer value and ability to electrically insulate equipment.

Chief advantages of the new resins over anything now known to be on the market are:

1. Resistance to temperatures up to 350° F.
2. Resistance to solvents as well as to acids and alkalis.
3. Setting or solidification at room temperatures.
4. Hard surfaces resistant to wear and impervious to moisture.
5. Brush coats are from 8 to 30 times the thickness of brushed or sprayed paint coats, thus giving considerably more corrosion protection for the same labor.

Metal Powder Press

During the past two years *The New Jersey Zinc Co.* have been collecting case histories on nonferrous pressed powder parts. Now they intend to publish quarterly a four page bulletin called the *Metal Powder Press*, which will present the data uncovered.

Free copies are available upon request to all executives, designers and engineers.

Repairing Damaged Floors

Stonhard Co., Dept. MF, 1306 Spring Garden St., Phila. 23, Pa.

A bulletin just released by the above firm tells you how you can make your floors smooth and safe in 3 easy steps. There is no delay in production schedules or traffic—Stonhard Stonfast is instantly ready to withstand heavy trucking and use, it is claimed.

For your free copy, write to the above address.

Nytron in Steel Pickling

Solvay Process Div., Allied Chemical & Dye Corp., Dept. MF, 40 Rector St., N. Y. 6, N. Y.

Just issued by this firm is a 14 page booklet describing the uses and advantages of Nytron, their new surface-active agent, in the pickling of iron and steel. The advantages claimed for this material are stability, compatability with inorganic salts, good wetting, detergent and inhibiting action, and extension of the active life of pickling baths. The results of laboratory and field tests are reported, as well as charts showing the relative compatability of this material and other commercial pickling inhibitors in various concentrations of inorganic salt solutions.

Copies of the booklet are available on request.

Reynolds Issues New Technical Manual on "Finishes for Aluminum"

A new 124-page 6 x 9-inch book, "Finishes for Aluminum," has just been issued by Reynolds Metals Company, Louisville, Ky. The book furnishes basic information on the various processes for applying surface finishes to aluminum, as well as the characteristics of the finishes so produced.

This publication is a revision of the two-volume book with the same title published in 1946. The main difference between the 1946 edition and the 1949 edition is that in the revision, the processes adapted to continuous production operations are separated from the finishes only partially adapted to mass production techniques as well as those not yet fully established.

The new book includes chapters on Characteristics and Properties of Aluminum, Cleaning Treatments, Mechanical Finishes, Chemical Treatments, Electrolytic Oxide Finishes.

Electroplated Finishes, Organic Finishes, Special Purpose Finishes, Controls and Tests. It is complete with a Table of Contents, Itemized Cross Index, and Index of Tables.

The tabular matter presents much new information on finishes for aluminum, including a guide for approximating typical costs over the whole range of finishes, typical finishing practices for various types of products, as well as valuable reference material on cleaning practices, chemical finishes, electroplating processes, a comparison of relative corrosion resistance of the various aluminum alloys, data on action of various chemicals on aluminum alloys, solution potentials of aluminum alloys and other metals, nominal chemical compositions, data on temper designations, mechanical properties, and the like.

This 1949 revision was made by *Jules F. Saut* and *Harlan D. Jones* under the supervision of *Dr. Geo. Perkins*, Director, Technical Service, Reynolds Metals Company.

The book will be sent without charge to engineers, metallurgists, finishing department foremen, and other company officials *requesting it on their company letterhead.* All requests should be sent direct to *Reynolds Metals Company*, 2500 *So. Third Street, Louisville* 1, *Ky.*

Evaluating the Present and Future Status of Your Business

A very interesting and informative booklet outlining to management and business planners methods for taking stock of their firm's present and future financial conditions and how they may be affected by changing business conditions, is contained in the booklet just published by the *Research Institute of America*, 292 *Madison Ave., New York* 17, *N. Y.* The subjects covered, in the form of examples and recommendations, are:

How to check your present position.
How to analyze your vulnerability, as prices drop or volume falls.
How to project Sales, Costs, Cash, Margins.
Figuring your future position
a) if you cut prices
b) if you spend more on promotion
c) if you iron out seasonal dips
d) if you invest in more efficient equipment

e) if you use lower grade materials
f) if you drop unprofitable sales
g) if you reduce overhead
h) if you subcontract work
i) if you change your capital structure.

Requests for copies should be made to the above address.

Acid Proof Cements

Sauereisen Cements Co., Dept. MF, Pittsburgh 15, Pa.

A new bulletin just released by this firm describes their complete line of acid proof cements for all types of chemical construction work where corrosive environments must be successfully withstood. Tables of characteristics, suggested applications, and prices are given. The line includes conducting cements, porcelain cements, sulfur cements, and various types of insulating cements. Copies of this bulletin are available on request.

Burnishing Barrels

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

Bulletin BB-104, entitled "Improved H-VW-M Mercil Type Burnishing Barrels" has been issued by the Hanson-Van Winkle-Munning Company. This bulletin covers the latest developments in these barrels, a description of their fifteen new features, and also gives engineering and construction data, operating advantages and specifications.

Prices on Buffing Compounds

The L. H. Butcher Co., Dept. MF, 3628 E. Olympic Blvd., Los Angeles, Calif.

The above firm has just issued a new price list on their line of buffing and coloring compositions. Included in the listing are tripolis, emery pastes and cake, stainless steel compounds, lime finishes, white silica compounds, tallow grease sticks, rouge, and liquid buffing compositions. Copies are available on request to the above address.

Overhead Materials Handling

The Cleveland Crane & Engineering Co., Dept. MF, Wickliffe, Ohio.

This firm has just issued a new catalogue describing their complete line of overhead conveyor materials handling equipment. The bulletin contains engineering information required for the efficient choice of such equipment.

and covers a wide range of materials handling requirements for all types of industries. Copies are available on request.

Vinyl Protective Coatings

Dennis Chemical Co., Dept. MF, 2701 Papin St., St. Louis 3, Mo.

The above firm has published a four-page folder entitled "Perma-Skin Vinyl Corrosion Resistant Protective Coatings." This folder is available to anyone interested in combatting corrosion of metal, wood, stone, brick, and concrete structures and equipment, by atmospheric and chemical action. The Perma-Skin system is applicable to a wide range of industries, covering structural installations, machinery and equipment of almost every type, and is the result of over 12 years of research in vinyl resins, according to the firm.

Polishing and Buffing Lathes

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

The above firm has issued Bulletin L-203 on Motor Driven Polishing and Buffing Lathes, describing and illustrating the following:

Type MS—for production plants and job shops, a general purpose machine.

Type MI—for smooth operation and the utmost convenience.

Type DMI—for continuous production with independent spindles.

Type MO—with the T.E.F.C. motor, overhang and work space.

Type VJ—a rugged small lathe for light polishing and buffing.

Type VCL—a low type machine for small parts.

Type VR—a bench lathe.

Type VH—for heavy duty work with semi-automatics available up to 20 H.P.

Type VH-X—a heavy lathe for tough jobs with semi-automatic work holders; available in 25, 30 and 50 H.P.

H-VW-M variable speed drives; also 2 and 3 speed drives.

H-VW-M backstand unit for speed cutting with indicated spring-cushioned belt tension.

Heat Exchangers for Plating Solutions

Industrial Filter and Pump Mfg. Co., Dept. MF, 1621-39 West Carroll Ave., Chicago 12, Ill.

This firm has just introduced a line of unit heat exchangers for plating solutions as operating conditions require, it is claimed, using pure nickel tubes for nickel solutions, and steel and special alloy tubes for other applications.

The heat exchangers can be furnished as a unit with a combination of from one to six tubes in multiple for a wide variety of heat exchange capacity. Special units are readily engineered for unusual capacity or space requirements. They are available complete with pump and stand for setting on the floor, or the tubes alone can be had separately for wall or ceiling mounting. They are easily connected to the plating system, and can be located anywhere that is convenient, according to the firm.

Further information and descriptive catalog page is available from the manufacturer.

Descriptive Bulletin on Chain Lubricators

Bel-Ray Co., Inc., Dept. MF, Green Village Rd., Madison, N. J.

This firm has recently published a bulletin announcing their new series of chain lubricators. These new lubricators are used for automatically applying lubricants to conveyor chains on ovens, furnaces, dryers, etc. Complete information covering details of application, installation, operation and ordering information are covered in Bulletin 31.

Pre-Plated Metals

American Nickeloid Company, Dept. MF, Peru, Ill.

A new two-color folder on zinc base metals, furnished in sheets, coils or flat strips, is now available, according to recent announcement by the above manufacturer.

Samples of both bright and satin finished metals attached to the folder's cover show off the striking finishes in which these zinc base metals come, plated on one or two sides, and furnished in striped or crimped patterns. Trade named Chromaloid, Nickeloid, Brassoid, Copperoid, Tint Zinc and Gold Bond Zinc, these pre-plated metals can be stamped, blanked, bent or formed to meet most production requirements, it is claimed.

Belt Conveyor Bulletins

Rapid-Standard Co., Inc., Dept. MF, Grand Rapids, Mich.

A new, two-color, four page bulletin describing and illustrating the Rapid Power Booster power belt conveyor line has been issued by this firm.

Challenger and Defender models are illustrated in the bulletin, with construction features singled out and listed separately. The bulletin is sectionalized to provide related grouping of outstanding features in a single panel for ease of reading.

Features of the booster presented in detail are the nosed-over delivery, power-driven feeder section, hydraulic telescoping center lift, simple screw pitch control and sub-bases.

A specifications page outlines Rapid Power Booster controls, belts, contruction of bed, available guard rails, casters and motors.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Schroeder Hotel, Milwaukee, Wisc.
Scene of AES 1949 Annual Convention.

New York Branch

At a recent meeting of the New York Branch, the following officers were elected to head up the branch activities for the coming year:

President—*Milton Nadel*, Consolidated Razor Blade Corp., Jersey City, N. J.

1st Vice-President—*George Hermann*, Ronson Products, Inc., Newark, N. J.

2nd Vice-President—*Joseph Haas*, Industrial Advisory Co., Norwalk, Conn.

Sec'y - Treasurer — *Franklin MacStoker*, Farrand Optical Co., Bronx, N. Y.

Financial Sec'y — *Martin Maher*, Oakite Products, N. Y. C.

Recording Sec'y—*Albert Fusco*, U. S. Metal Prod. Co., Brooklyn, N. Y.

Sargeant at Arms—*Angelo Amatore*, Brooks & Co., New York, N. Y.

Librarian—*Derrick Hartshorn*, Enthone, Inc., New York, N. Y.

Trustees—*William Schneider*, E. I. DuPont de Nemours Co., New York, N. Y.; *George Schore*, Detrex Corp., New York, N. Y.; *Al Braun*, Agate Lacquer Mfg. Co., L. I. City, N. Y.

Tenth Annual New England Regional Meeting

The tenth annual New England Regional Meeting of the A.E.S. was held at the Hotel Kimball, Springfield, Mass. on April 28th. This annual affair is a cooperative effort by the various branches in the New England area, and this year's meeting presented an outstanding technical session and an enjoyable social aftermath, attended by about 375 members, wives, and guests.

The technical session opened with a discussion of Tin Plating by *Mr. Paul Lyman*, of the Millers Falls Tool Co. He stressed the importance of operating tin baths at the correct voltage; too low a voltage producing stannite tin, and too high a voltage producing excessive decomposition of the bath. His experience was that voltage control was equally as important as current density control in plating tin from alkaline baths.

The second speaker was *Mr. Oscar Stocker*, of the Seymour Mfg. Co., who discussed in some detail the various causes for defective plating from bright nickel baths and their remedy or pre-

vention. This was followed by a discussion of Brass Plating by *Mr. Bert Sage*, of the Mattatuck Mfg. Co. Among the highlights of Mr. Sage's talk was the discussion on making up new brass plating baths to give an immediate brass color, eliminating the need for an extensive "breaking in" period.

Bill Cullen, of the Stanley Works, concluded the forum with a talk on Zinc Plating, including some interesting comments on the use of case-hardened steel for inside anodes and the plating of cast iron by a preliminary cadmium flash or a flash in the zinc bath at very high current densities before the regular plating cycle. He also devoted some time to a discussion of bright dips for zinc plated parts.

Following the forum, *Mr. Walter Pinner*, Manager of Research and Development for the Houdaille-Hershey Corp., presented a talk on the preparation of steel for decorative plating. The multitude of photomicrographs shown of the types of surfaces produced by various abrasive operations attested to the importance of this subject to the metal finishing industry. Mr. Pinner closed his talk with some interesting comments on the possibilities of electropolishing in the improvement of surfaces and the elimination of surface roughness of plated deposits.

The evening's social events, beginning with an excellent steak dinner and concluding with a first-class floor show and dancing, topped off the day's events, and much credit is due *Mr. Ed Dupuis*, the General Chairman, and his staff for putting on a most enjoyable affair.

Detroit Branch

Stag Day

The Detroit Branch of the A.E.S. is staging their Annual Stag Day on July 30, 1949 at the Forest Lake Country Club. Tickets are available from *Frank Clifton*, 16536 Inverness, Detroit 21, Michigan, at the bargain price of $5.00.

Golf will start at 9:00 a.m. for which a special green fee of $2.00 (in addition to the $5.00 ticket) has been arranged. *Stan Krentel* and *Charlie Conley* have lined up a soft ball game or two, barnyard quoits (horseshoe pitching), bait casting contests for accuracy (fishermen take note), baseball throwing at milk bottles, and the old favorite of guessing how many beans in a bottle. *Fred Wagner* is lining up a large quantity of door awards with one big grand award of a Television Set.

Don't forget the date of July 30th, and get your reservations in early so you won't be left out.

Rochester Branch

The regular monthly meeting of the Rochester Branch was held at the Hotel Seneca on Friday April 15.

A motion was made for the establishment of a Branch Library at the Rochester Institute of Technology by *Mr. Swanton*. *Mr. Hull* moved that the Librarian and Mr. Swanton meet to work out details of such a plan and report at the next meeting.

A letter from the Milwaukee Convention was read inviting us to enter an exhibit from our Branch. It was decided that the Rochester Branch would not exhibit this year. The fol-

lowing nominations for officers for the coming '49 and '50 season have been made by the Board of Managers:

President—Joe Hull

Secretary—Gordon McDonald

Treasurer—Fred Wagner

1st Vice President—James Weaver

2nd Vice President—Charles Henderschott

Librarian—John Duford

Board of Managers –Robert Flint, Clinton Murray, John Lindsey, John Adams, Sylvester Gariland

Elections were to be held during the May Meeting.

Mr. Du Rose presented a paper on the Harshaw Perflow Nickel Process, and showed various slides to illustrate his talk.

Twin City Branch

The Twin City Branch of the American Electroplaters' Society met in Minneapolis on May 2nd, 1949.

In addition to the 29 members present, there were five (5) guests present: *Raymond Kotz*, of Belke Mfg. Co.; *Chas. F. Norcross*, of Richardson-Allen Corp.; *John Mitchell*, of Pako Corp.; *Verne Danielson*, of Northern Ordnance; and *Bruce Jackson*, of Oakite Products.

The meeting opened with a request from the President that a discussion be held relative to the type of speakers the members desired and the subjects that would be of interest in order to guide our new Branch Librarian, *Gunnar Deedon*, of Turco Products. Following the discussion, an announcement was made relative to the coming 5th Annual Party of the Twin City Branch which will be held on Monday, June 6th, at 7:00 p.m. in the Lodge Room of the Covered Wagon, and that tickets were available from members of the Party Committee, headed by *George C. Reed*, of Minneapolis Honeywell, or members of his Committee or members of the Board of Managers.

A letter was read from the Chairman of the Auditing Committee, headed by *Arthur M. Carlson*, of Arlington Machine Works, Inc., which stated that the Auditing Committee had checked the books of the Treasurer and found them to be in order and current.

It was announced that we were looking forward to having a bigger and better Convention Exhibit than ever before to be shown at the coming Annual Convention in Milwaukee and it was hoped that many of our new members would take an interest and prepare an exhibit.

Following the business meeting the Branch Librarian, *Wray Schorr*, of Hiawatha Metalcraft, announced that the speaker planned for this meeting was unable to attend the meeting and he had arranged for three movies, "Bass Fishing, Pheasant Fever and Abbott & Costello." The movies were very good and were followed by an informal social session.

Buffalo Branch

The Buffalo Branch of the AES held their Annual Northeastern Regional Meeting and Banquet at the Hotel Markeen, Buffalo, on May 7th. The meeting drew an attendance of about 175 members and guests, and featured an excellent technical session, followed by the Annual Banquet and entertainment in the evening. The installation of new officers for the coming year was conducted at the banquet. This method of presenting the incoming

officers to the members and guests is very impressive and effective, and could well be copied by other branches. The new officers are *Otto Kirchoff*, President; *Anthony Nigro*, 1st Vice-President; *J. Moneypenny*, 2nd Vice-President; *F. Nowakowski*, Treasurer; *H. Fudeman*, Secretary; *W. M. Fotheringham*, Librarian; *H. G. Wall*, Sergeant-at-Arms; and *J. Ruff*, *S. Bush*, and *L. Davis*, Board of Managers.

The technical session was opened by *Mr. Oscar Stocker*, Manager of the Rufert Chemical Co., who spoke on the various methods for purification of plating solutions, with special emphasis on bright nickel baths. He gave details of both precipitation methods and electrolytic methods of bath purification. Following Mr. Stocker, *Mr. Walter Helbig*, Chem. Eng. of Darco Corp. spoke on the many problems and phases of filtration of plating baths, and *Mr. Harold Faint*, Manager of the Industrial Filter & Pump Mfg. Co., talked about the methods used and the advantages to be gained in using demineralized water in metal finishing operations. The great interest in all these subjects was attested to by the numerous questions put forth by the audience and capably answered by the panel of speakers.

After the banquet, dancing was enjoyed until 1 a.m., preceded by an excellent floor show and the distribution of many beautiful door prizes. The program committee, headed by *Dr. C. J. Wernlund* and ably assisted by the branch members, is to be congratulated on an outstanding affair, enjoyed by all who attended.

Los Angeles Branch

The Los Angeles Branch of the American Electro-Platers' Society held its May meeting in the plant of the *L. H. Butcher Company*, as guests of the management. This was the third consecutive year in which this plating supply concern acted as host to the entire branch. Dinner was served in the spacious cantine of the company's main building. This dinner meeting annually attracts the branch's largest attendance, the 1949 session being attended by a total of approximately 185, of which 52 were guests.

Jack Raskin, head of the company's plating supply division, and *Frank Bunker*, sales engineer and past-president of the Branch, were on the job as chief welcomers. Members of the Butcher Company's sales and laboratory staffs donned white aprons and in the capacity of waiters and bus boys, demonstrated all the efficiency of members of the Waiters Union in satisfying the gustatory demands of the branch members. The "waiters" included *Earl Arnold*, chief of the Butcher Company plating laboratory; *Al Perkins*, *Dean Williams*, *Harold Preston*, *Frank Virgil and Kim Jung*. Another energetic volunteer waiter was *Jerry Levy*, of Cooperative Industries. Messrs. Raskin and Bunker topped off a splendid dinner by passing around cigars.

The business session was presided over by Branch President *Allie Sulzinger*. So many visitors were present (52) that Sergeant-at-arms *Gus Brigantino* announced he had decided to introduce them "in bulk" instead of in-

dividually. All visitors were then welcomed collectively by President Sulzinger.

Six new members were initiated. These included: *Miss Florence English* (the Branch's first woman member), chemist of the Modern Plating Co.; *H. D. Shaw*, Cadmium & Nickel Plating Co.; *George E. Amond*, El Toro (Calif.) Marine Base; *Phillip Greathead*, president Square Deal Machine Co., South Gate, Calif.; *Ed F. Ward*, Arrow Plating Co.; and *Charles DeCuir*, Modern Plating Co.

In a discussion on instructions to be given the national convention delegates, Frank Bunker, chairman of the Board of Managers, reported it was the board's opinion that the current Supreme Society requirement pertaining to payment of the per capita tax involved inequities that were not favorable to the branches. He pointed out that requiring the payment of the per capita tax in a lump sum early in the year resulted in the Branches paying a whole year's tax in advance on some members who may have to be expelled before the year's end for nonpayment of dues, etc.

Los Angeles delegates (*Don Bedwell, Dick Wooley and Charles Russill*) were instructed that if the matter of again readjusting the per capita tax system should come up for discussion at the Milwaukee convention, Los Angeles Branch's opposition to the present method of payment should be recorded. The membership approved a motion that the branch defray a portion of the delegates' convention expenses.

The speaker at the meeting was *Arthur D. Gaskia*, supervisor of the L. H. Butcher Company's compound department. His talk on "Buffing and Polishing Compounds" represented a collaboration of himself and of the company's *Harry Hunt*, who performed various laboratory demonstrations with buffing and polishing compounds to highlight portions of the talk.

Chicago Branch

The speaker for the May 13th meeting of the Chicago Branch was *Mr. Gerald Lux*, of Oakite Products, who spoke on "Cleaning Prior to Plating." Mr. Lux demonstrated the action of various materials on water of various hardness, which served to illustrate several of the points under discussion.

Due to the scope of the subject under discussion it was not possible in the time allotted to thoroughly cover all phases of metal cleaning; however, the author brought out that temperature is most important in metal cleaning, and that with each increase of 10° F. in a cleaner operated at a temperature of 140° F. and over, we would observe a decrease in cleaning time of approximately 50%. It was also brought out that there is a pH range under which many cleaners operate most effectively, with a resultant increase in cleaning time at a pH below or above these values. Mr. Lux pointed out the effect of oxygen in a cleaner on discoloration of brass parts being cleaned. A case was cited in which the brass parts being cleaned were tarnished shortly after water had been added to the cleaner, but that in a period of time the oxygen worked

Mr. G. A. Lux
Guest speaker at Chicago Branch meeting.

out of the cleaner to the point where the tarnish was no longer troublesome. Where this problem does exist the speaker suggested adding small quantities of water at more frequent intervals.

Mr. Lux's talk was followed by the usual open question session, in which some problems were quite lively discussed.

The following new members were recently elected: Alfred K. Nelson, Howard C. Warren, Oscar Pierremont, Ray M. Stege, Frank J. McNally, Werner M. Neukranz, and Sanford M. Linick.

Newark Branch

Dr. Herbert Bandes, head of the electrochemistry research section of Sylvania Electric Products Inc., Bayside, New York delivered a paper on "Homologous Series of Plating Solutions" at the May 20th meeting of the Branch.

He said that heretofore the classification of plating solutions has been according to the metal which is electrodeposited, such as copper, zinc cadmium and tin, which are commonly plated from an acid or an alkaline solution. He proposed taking various types of plating solutions and developing changes in solution compositions and operating conditions which are necessary as the metallic ion is changed. Specific examples of the process he proposed exist in the case of fluoborate solutions, which can be used for the electrodeposition of tin, lead, cadmium and zinc. The changes in solution composition, plating current density, bath temperature and the concentration of hydrogen ions were discussed with reference to the metal ion species, its position in the periodic table and other factors.

Dr. Bandes said that similar homologous series involve cyanide solutions, sulphate or chloride solutions and various amines.

NATIONAL ASSOCIATION OF METAL FINISHERS

The National Association of Metal Finishers, which is composed of a federation of local associations of job platers and enamelers, are holding their 4th annual meeting in Milwaukee, Wisconsin, in connection with the 36th Annual Convention of the American Electro-Platers Society.

The Board of Directors of the Association are holding their annual

meeting all day on Tuesday, June 28, and the annual meeting of members and election of officers will be held that Tuesday evening. Headquarters will be at the Schroeder Hotel, and the above meetings will also be held at the Schroeder.

All members of the job plating industry in attendance at the A.E.S. convention are invited to attend the meeting of the members of the National Association of Metal Finishers, at which time the accomplishments of the National Association will be reviewed.

ASTM

In addition to 22 officially numbered technical sessions scheduled for the 52nd (1949) Annual Meeting of *The American Society for Testing Materials*, Atlantic City, during the week of June 27, there are a number of other informal sessions and round-table discussions which will be of much interest. There will be symposiums and groups of technical papers, and reports of interest to those concerned with ferrous and non-ferrous metals: cementitious, concrete and related fields; rapid identification of metals; bituminous materials; and many others.

Throughout the entire five days of the meeting scores of the A.S.T.M. technical committees will be in session perfecting and completing work on specifications and tests that have been under way, and initiating new research and standardization work. In addition to the extensive business to be transacted, there is to be a social period on Wednesday evening, June 29, when the hosts for this meeting, the Philadelphia District, are sponsoring an informal program of entertainment. All sessions are at Chalfonte-Haddon Hall.

Another interesting innovation in the program is the official luncheon session scheduled for Tuesday noon, June 28, when President *R. L. Templin* will give the annual President's Address, 50-year members will be recognized, and other honors awarded.

A cordial invitation is extended to all interested in the phases of the meeting to attend.

Electrochemical Society

At the recent 95th meeting of the Electrochemical Society held in Philadelphia on May 4-7, new officers were elected to head the Society for the coming year. They are as follows:

President—*A. L. Ferguson*, Univ. of Michigan

Vice-Pres.—*J. C. Warner*, Carnegie Inst. of Technology

Secretary—*H. B. Linford*, Columbia Univ.

Treasurer—*E. G. Weidell*, Radio Corp. of America

The technical sessions featured symposia on luminescense, rare metals, and theoretical electrochemistry. *Michael A. Streicher*, of the E. I. Du-Pont Co. received both the Young Authors Prize and the Turner Book Prize awarded yearly by the Society.

Letter to the Editor

Dear Editor:

In a recent issue of Metal Finishing I noticed an article in the shop problems section concerning Heavy Tin Plating. I have had some experience with this and have overcome many of the obstacles.

It was necessary at one time for me to plate a tapered shaft with .005" of tin. At first we experienced the same trouble as the writer had, but soon this was overcome.

The bath and procedure used was as follows:

Sodium Stannate	2.5-3 *oz/gal.*
Caustic Soda	2-2.5 *oz/gal.*
Sodium Acetate	*Trace*
Temperature	140-145 *deg. F.*
Peroxide	*As needed depending upon use.*

We used current direct from the bus bars to the tank, using either six or twelve volts, depending upon the amount of surface area to be plated.

The parts were cleaned in the normal manner and given a copper flash to insure a clean surface, but this can be eliminated. The hydrogen peroxide additions were made daily when the tank was in constant use. A normal addition was about 1 pint, but this depends upon proper control of the temp. and the amount of usage of the solution.

It is true that with this type of solution it is necessary to run each load much longer than usual because of the low concentration, but the results were very good. Our deposits were frosty white and free from any stains, burns or spongy appearance, and above all, thickness was maintained. It was very necessary to constantly keep the peroxide additions up and temperature maintained within the 140-145 deg. F. range.

I hope that this may help solve the writer's problem.

Yours truly,

A. C.

NEW BOOKS

35th Annual Proceedings of the American Electroplaters' Society

Published by the American Electroplaters Society, Box 168, Jenkintown, Pa. Price $5.00 per copy.

This volume contains the complete

papers, with discussions, presented at the Annual Convention held at Atlantic City in June, 1948, as well as the condensed record of activities at the Convention and Exhibit. The following papers are included:

Physical Properties of Electrodeposited Nickel by *A. Brenner & C. W. Jennings.*

Spiral Contractometer for Measuring Stress in Electrodeposits by *A. Brenner & S. Senderoff.*

Effect of Stress on Thickness Measurements by the Jet Method by *H. J. Read & J. H. Thompson.*

Judging the Quality of Plated Parts by *W. M. Phillips & F. L. Clifton.*

Measurement of Intrinsic Porosity of Plated Metals by *N. Thon & D. K. Keleman.*

Effect of Copper in Nickel Solutions on the Salt Spray Resistance by *D. T. Ewing, R. Rominsky, & W. King.*

Oxidation of Trivalent Chrome In Chrome Plating Solutions by *R. Seegmiller & V. Lamb.*

Bright Barrel Plating of Nickel and Zinc by *L. A. Chesworth.*

Plating High-Copper-Zinc Alloys by *A. K. Graham.*

Depositing Metals on Plastics Using Reduced Copper films by *H. Narcus.*

Strip Plating Evaluation in a Circulating Electrolyte Cell by *R. A. Dimon.*

Electroplaters Metals of the Future by *F. A. Lowenheim.*

Diaphragm Tanks to Eliminate Roughness in Copper Plating by *R. H. McCahan, C. H. MacKinnon & D. A. Swalheim.*

Simple Test for Metal Cleanliness by *G. B. Hogaboom.*

Industrial Electropolishing by *C. L. Faust & E. R. Graves.*

Electropolishing Silver in Cyanide Baths by *D. Gray.*

Engineering Planning in the Plating Room by *S. M. Martin.*

Practical Cost Finding Methods and Estimating for Metal Finishes by *A. Bregman.*

Importance of Acid Ratio in Phosphating Steel by *N. F. Murphy & M. A. Streicher.*

Design and Production Costs of a Conveyorized Spray Finishing System by *E. P. Schwartz.*

The Development of Theoretical Electrochemistry

By Raymond M. Fuoss, Phi Lambda Upsilon, Dept. of Chemistry, Pennsylvania State College, State College, Pa. Price $2.00 per copy.

This booklet contains the series of five lectures given annually in commemoration of Joseph Priestly and known as the Priestly Lectures. This year's lecturer, Prof. Fuoss, is Sterling Professor of Chemistry at Yale University, and his series covers the following subjects:

Volts versus Amperes
Electrolyses; Puzzles and Progress.
Precision Enters Experiment
Precision Enters Theory
The Ionic Atmosphere

In this series Prof. Fuoss discusses the highlights of progress in theoretical electrochemistry from the time of Henry, and including the important contributions made by other pioneers in the field: Volta, Galvani, Carlisle, Cruickshank, Davy, Wollaston, Priestley, Ohm, Wheatstone, Hittorf, Kohlrausch, Arrhenius, Van't Hoff, Ostwald, Sutherland, Noyes, and many others.

This chronological development of our present day theories of electrochemical action is discussed by Prof. Fuoss in an interesting and forceful manner, and will make enlightening reading to all interested in this subject. We get a good idea of the tremendous progress made in this field after reading how Volta, for lack of a better means of measuring the voltage from his earliest galvanic cells, placed the electrodes inside his ears and mouth and noted the degree of shock created.

W. A. R.

Corrosion Characteristics of Metal Pipe Used in Sprinkler Irrigation Systems

By Tom Wahl and William W. Boyd. Published by the Div. of Industrial Research, State College of Washington, Pullman, Wash.

A 52 page report of research progress in this important agricultural subject, giving corrosion rates obtained at various locations, comparisons of the effectiveness of various metals and alloys and protective coatings, etc. The data is supplemented with many photographs and photomicrographs. Copies are available without charge.

News from California

Hollywood Bronze Supply, Hollywood, Calif., recently expanded its engineering facilities under the direction of *George Slomin*, nationally known electrochemist, and in response to a demand in the jewelry trades for small plating units for gold, silver and copper, is now manufacturing such units in its Los Angeles plant.

The company has for a number of years manufactured selenium rectifiers, plating equipment and mountings for bronzing baby shoes. The firm's line of plating equipment for jewelers includes tanks for gold and silver of 2, 5, and 15 gallon capacity.

William Nairne, sales engineer at Los Angeles headquarters of the *A. J. Lynch Co.*, has been transferred to the central California area to serve the plating and organic finishing industries in the northern San Joaquin Valley district, and northward to San Francisco and Oakland. His headquarters are in the company's San Francisco office.

Harold Wells, formerly a process and service engineer for Lockheed Aircraft Co., and more recently with the Victor Chemical Co. of Los Angeles, has been added to the Lynch Company's Southern California sales engineering staff.

Los Angeles Chemical Co. has announced the appointment of *Jack Stone*, who served as a sales engineer for the past three years, as head of the company's plating supply division, succeeding to the post held for many years by the late *Carl Dennis*, who passed away last February.

Oronite Chemical Co., San Francisco, a Standard Oil Co. subsidiary, has announced the following executive changes:

J. D. Deane, vice-president, transferred from New Orleans, La., to San Francisco to direct all Oronite manufacturing operations.

T. I. Calusen, assistant manager of the chemical division of California Research Division, also a Standard subsidiary, transferred to Oronite Chemical Co. as general superintendent at New Orleans.

Walter A. Blair has been named branch manager of a new branch office recently opened in San Francisco by the *Precision Scientific Co.* of Chicago. He was formerly a product design engineer with Fansteel Metallurgical Corp.

The Stainless Steel Polishing Co., 200 North Avenue 18, Los Angeles, recently installed facilities for deep drawing and forming metal, on a jobbing basis, of stainless steel, aluminum and mild steel.

A new 15,000 square foot building is being erected at 4010 East 26th Street, Los Angeles, by *Federated Metals Division* of the *American Smelting and Refining Co.* The firm produces ingot brass, bronze and aluminum, slab zinc and trophy metal.